

Project Manual - Volume 2

Technical Specifications (Divisions 22 thru 33)



Lowville Academy & Central School

“Protecting Our Future” Capital Project

Academy School - SED Control No. 23-09-01-04-0-001-022

Bus Garage - SED Control No. 23-09-01-04-5-005-008

New Press Box - SED Control No. 23-09-01-04-7-018-001

Lowville, NY

Owner:

Lowville Academy & Central School
7668 North State Street
Lowville, NY 13367

Architect:

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258 Genesee St., Suite 300
Utica, NY 13502

Construction Manager:

Turner Construction Company
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Syracuse, NY 13204

Landscape Architect:

Appel Osborne
102 W. Division Street, Suite 100
Syracuse, NY 13204

Structural Engineers:

IE Solutions, PC
1721 Black River Blvd., Suite L1
Rome, NY 13440

M/E/P Engineers:

FS Engineering, DPC
721 East Genesee St.
Syracuse, NY 13210

MARCH No. 2194

November 30, 2023

BID SET NO. _____

DOCUMENT 00 01 01

PROJECT TITLE PAGE

LOWVILLE ACADEMY & CENTRAL SCHOOL

“PROTECTING OUR FUTURE” CAPITAL PROJECT

ACADEMY SCHOOL - SED CONTROL NO. 23-09-01-04-0-001-022

BUS GARAGE - SED CONTROL NO. 23-09-01-04-5-005-008

NEW PRESS BOX - SED CONTROL NO. 23-09-01-04-7-018-001

LOWVILLE, NY

THE ARCHITECTS AND ENGINEERS THAT HAVE SIGNED THIS DOCUMENT CERTIFY THAT TO THE BEST OF THEIR KNOWLEDGE, INFORMATION AND BELIEF, THE PLANS AND SPECIFICATIONS ARE IN ACCORDANCE WITH APPLICABLE REQUIREMENTS OF THE NEW YORK STATE UNIFORM FIRE PREVENTION AND BUILDING CODE, THE STATE ENERGY CONSERVATION CONSTRUCTION CODE, AND CONSTRUCTION STANDARDS OF THE STATE EDUCATION DEPARTMENT. NO ASBESTOS CONTAINING MATERIALS ARE SPECIFIED.

OWNER:

LOWVILLE ACADEMY & CENTRAL SCHOOL
7668 NORTH STATE STREET
LOWVILLE, NY 13367

ARCHITECT:

MARCH ASSOCIATES
ARCHITECTS & PLANNERS, PC
258 GENESEE STREET, SUITE 300
UTICA, NY 13502

CONSTRUCTION MANAGER:

TURNER CONSTRUCTION COMPANY
500 PLUM STREET, SUITE 101
SYRACUSE, NY 13204

LANDSCAPE ARCHITECT:

APPEL OSBORNE
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SYRACUSE, NY 13204

STRUCTURAL ENGINEERS:

IE SOLUTIONS, PC
1721 BLACK RIVER BLVD., SUITE L1
ROME, NY 13440

HAZARDOUS MATERIALS:

BARTON & LOGUIDICE
443 ELECTRONICS PARKWAY
LIVERPOOL, NY 13088

M/E/P ENGINEERS:

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721 EAST GENESEE ST.
SYRACUSE, NY 13210

MARCH NO. 2194

NOVEMBER 30, 2023

MARCH No. 2194
00 01 01/1

SEALS PAGE

LOWVILLE ACADEMY & CENTRAL SCHOOL




“PROTECTING OUR FUTURE” CAPITAL PROJECT

ACADEMY SCHOOL - SED CONTROL NO. 23-09-01-04-0-001-022

BUS GARAGE - SED CONTROL NO. 23-09-01-04-5-005-008

NEW PRESS BOX - SED CONTROL NO. 23-09-01-04-7-018-001

I hereby certify that the plan, specification, or report was prepared by me or under my direct supervision, and that I am a duly Licensed Architect or Licensed Professional Engineer under the Laws of the State of New York.

<p>ARCHITECT: MARCH Associates Architects & Planners, PC David D. Jadowski NYS License No.: 036964-01 Valid through: 02/28/2026</p>	
<p>STRUCTURAL ENGINEER: Interactive Engineering Solutions Douglas R. Cahill NYS License No.: 061675 Valid through: 03/31/2026 Certificate No.: 0019642, exp. 12/31/2023</p>	
<p>HAZARDOUS MATERIALS ENGINEER: Barton & Loguidice, DPC Scott D. Nostrand NYS License No.: 075454-1 Valid through: 10/31/2024 Certificate No.: 0018246, exp. 12/31/2023</p>	

M/E/P ENGINEER:

FS Engineering, DPC
Elizabeth P. Fisher
NYS License No.: 096006-01
Valid through: 01/31/2024
Certificate No.: 0019642, exp. 01/31/2025



LANDSCAPE ARCHITECT:

Appel Osborne Landscape Architecture
Cory M. Jenner
NYS License No.: 002097
Valid through: 09/30/2025



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BUS GARAGE - SED CONTROL NO. 23-09-01-04-5-005-008

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STRUCTURAL

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SECTION 22 00 10

GENERAL REQUIREMENTS FOR PLUMBING

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 the Work of this Division.
 - 1. The intent of this Section is to complement Division 01 Specifications and to provide supplementary, trade-specific information.
 - 2. Refer conflicting requirements to Architect for a decision before proceeding. If a resolution is not obtained, assume the costliest to apply.
- B. Thoroughly study all Drawings and Specifications before submitting bids.
- C. Drawings and Specifications are to be considered as supplementing each other. Work specified but not shown or shown but not specified shall be performed or furnished as though mentioned in both Specifications and Drawings.
- D. Details on Drawings are to be considered typical for similar applications unless specifically noted otherwise.

1.2 SUMMARY

- A. Bid shall include the cost of all labor, materials, tools, transportation, equipment, insurance, temporary protection, rentals, permits, taxes, and all necessary and miscellaneous items required to provide various systems shown and described complete and in good operating condition whether or not these miscellaneous items are specifically described in the Specifications or shown on the Drawings.
- B. Install all work in accordance with all applicable codes and prepare supplemental detail drawings and Shop Drawings reflecting purchased equipment requirements as necessary to obtain approval of authorities having jurisdiction over this Project.
- C. Guarantee workmanship, materials, and performance of this Division's systems in accordance with the requirements of the Contract Documents.
- D. The following are specifically included without limiting the generality implied by the Drawings or Specifications:
 - 1. Plumbing systems including:
 - a. Sleeves and sleeve seals for plumbing piping.
 - b. Escutcheons for plumbing piping.
 - c. General-duty valves for plumbing piping.
 - d. Hangers and supports for plumbing piping and equipment.
 - e. Identification for plumbing piping and equipment.
 - f. Plumbing piping and equipment insulation.
 - g. Commissioning of plumbing systems.
 - h. Domestic-water piping and piping specialties.
 - i. Domestic-water pumps.
 - j. Facility indoor potable-water storage tanks.
 - k. Sanitary waste and vent piping, and waste piping specialties.
 - l. Sanitary drains.
 - m. Fuel-fired domestic-water heaters.
 - n. Commercial plumbing fixtures.
 - o. Pressure water coolers.
 - p. Facility natural-gas piping.

2. Apply firestopping to penetrations of fire-rated construction, to restore original fire-resistance rating of assembly, and as indicated in this Division's Specifications. Comply with requirements in this Section.
3. Submittal of forms and Drawings to review and permit agencies.
4. Submittals.
5. Record Documents.
6. Permits and Inspections: Apply for and obtain all required permits and inspections for all work in this Contract; pay all related fees and charges.

1.3 ALLOWANCES

- A. Refer to Division 01 Specifications.

1.4 UNIT PRICES

- A. Refer to Division 01 Specifications.

1.5 ALTERNATES

- A. Refer to Division 01 Specifications.

1.6 PROJECT MANAGEMENT AND COORDINATION

- A. General Requirements:
 1. Drawings show general design arrangement; install work substantially as indicated. Verify exact location and elevations on job. **DO NOT SCALE DRAWINGS.**
 2. Due to small scale of Drawings, it is not possible to indicate all offsets, fittings, changes in elevation, interferences, etc. Adjust installation of piping, ductwork, conduit, equipment locations, etc., to accommodate work with obstacles and interferences encountered.
 3. Advise the Construction Manager in timely manner of questions on equipment locations, heights, etc.
 4. Any reasonable location adjustment of equipment and associated services requested by the Architect/ Construction Manager, prior to work being installed, shall be done with no cost added to the Contract.
- B. Coordination with Other Divisions:
 1. Provide to other Divisions any information related to their appropriate trade concerning the equipment or any work of this Contract in ample time to prevent delay in building progress.
 2. Interference:
 - a. Thoroughly coordinate work with other Divisions and:
 - 1) Determine exact route or location of each piece of equipment, associated services, etc., before fabrication and installation.
 - 2) Maintain maximum headroom.
 - 3) Obtain Engineer's review before installing any work below 7'-0" clear headroom in mechanical areas.
 - 4) Install work of this Division so that all equipment is serviceable and operable.
 - b. Should Architect's details, field conditions, changes in equipment, or Shop Drawing information necessitate an important rearrangement, advise Architect and act in accordance with his directions.
- C. Coordination with Drawings: Review all Drawings and if necessary, request copies of Shop Drawings to coordinate work. If potential conflict occurs between this Division's Drawings and another Drawing, advise Construction Manager and Architect in writing. Do not proceed with work without written directive from Contract-designated authority.

- D. Scheduling and Procedure of Work:
1. The work of this Division shall be completed in accordance with Project schedule; otherwise, the Construction Manager shall have the right to install, at this Division's expense, any temporary work of this Division necessary to meet the scheduled completion date.
 2. As work occurs within or attached to existing structures:
 - a. Perform all work only on approved schedule.
 - b. Do not interfere with normal operation of existing systems.
 - c. Do not shut off any services without written authorization of Construction Manager.
 - d. Do as much work as possible prior to the shutdown to minimize the downtime.
 - e. Make temporary connections as necessary to maintain schedule agreed upon, with no cost added to the Contract.
 3. No radios, tape players, compact disc players, etc., shall be permitted on-site.
 4. Proper work attire shall be worn at all times.
 5. All Contractor personnel working at the Project site must obtain and display a valid identification badge. All vehicles must display a valid parking permit. Refer to Division 01 Specifications for additional requirements, such as parking permits and identification badges.

1.7 SUBMITTALS

- A. Supply submittals indicated in each Section of this Division's Specifications and in accordance with requirements of Division 01 Specifications. Supply separate submittals for each Section of Specifications and for each building.
- B. Wiring Diagrams: Electrically operated equipment shall include factory-approved wiring diagram illustrating proper connections to be made between equipment and power and equipment and auxiliary controls (where applicable).
- C. Penetration Firestopping: Submit product data and installer certificates signed by installer certifying that products have been installed in compliance with requirements.
- D. Clearly label each submittal with item name/description; Specifications' section, paragraph and/or subparagraph; and any pertinent Drawing detail reference information.
- E. Submit field quality-control reports when indicated in Part 3 of Division's Specifications.

1.8 QUALITY REQUIREMENTS

- A. Contractor shall be licensed in accordance with New York State General Business Law, Article 6-D.
- B. Observation of the Work:
 1. Architect/Engineer may make periodic visits to the job site to observe the general progress and quality of the work. Architect/Engineer will not make continuous or detailed on-site inspections to check the quality and/or quantity of work and will not be responsible for this Division's failure to carry out construction work in accordance with the Contract Documents, Project schedule, or unsound construction procedures or practices.
- C. Conflict Requirements:
 1. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.

- D. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not, including the following:
 - 1. Potable Domestic Water Piping: Follow cleaning procedures specified in Division 22 Section "Domestic Water Piping," and submit water samples in sterile bottles to NYS Department of Health-approved lab, with results sent to Engineer.

1.9 REFERENCES

- A. Industry Standards:
 - 1. The following standards shall govern and shall constitute minimum requirements as approved. If the requirements of this Division's Specifications exceed those of the standards mentioned, this Division's Specifications shall govern.
 - a. Local and state building codes.
 - b. Local utility companies.
 - c. National Electrical Manufacturer's Association ("NEMA").
 - d. American Institute of Electronic and Electrical Engineers ("IEEE")
 - e. National Electrical Safety Code ("NESC").
 - f. National Electric Code ("NEC").
 - g. ETL, Factory Mutual ("FM"), or Underwriters Laboratories, Inc. ("UL"), approved or listed, wherever applicable to materials.
 - h. American National Standards Institute ("ANSI").
 - i. National Plumbing Code ASA A40.8.
 - j. National Fire Protection Association ("NFPA")
 - k. Official Compilation of Codes, Rules and Regulations of the State of New York ("NYCRR") for education, health, and sanitary rules and regulations, including:
 - a) NFPA 101, Life Safety Code, 2015 edition (Part 711.2).
 - 2) Chapter XXXIII – State Fire Prevention and Building Code Council, including:
 - a) Subchapter A – Uniform Fire Prevention and Building Code (Uniform Code):
 - (1) Uniform Fire Prevention and Building Code (Part 1219).
 - (2) Residential Construction (Part 1220).
 - (3) Building Construction (Part 1221).
 - (4) Plumbing Systems (Part 1222).
 - (5) Mechanical Systems (Part 1223).
 - (6) Fuel Gas Equipment and Systems (Part 1224).
 - (7) Fire Prevention (Part 1225).
 - (8) Property Maintenance (Part 1226).
 - (9) Existing Buildings (Part 1227).
 - (10) The following documents by reference: 2020 Residential Code of New York State, 2020 Plumbing Code of New York State, 2020 Mechanical Code of New York State, 2020 Building Code of New York State, 2020 Fire Code of New York State, 2020 Existing Building Code of New York State, 2020 Fuel Gas Code of New York State, and 2020 Property Maintenance Code of New York State.
 - b) Subchapter B – State Energy Conservation Construction Code (Energy Code):
 - (1) State Energy Conservation Construction Code (Part 1240).
 - (2) The following documents by reference: 2020 Energy Conservation Construction Code, 2016 ASHRAE 90.1, and 2007 ASHRAE 183.
 - l. Federal Register Americans Disabilities Act ("ADA"); and ICC/ANSI A117.1, the Handicapped Accessibility Code.

- m. New York State Education Department ("SED") "Manual of Planning Standards."
 - n. Lewis County Administrative Rules and Regulations.
 - o. Any other standards mentioned in this Division's Specifications.
- B. Materials and Equipment:
 - 1. Electrical devices, materials, and packaged equipment shall be listed and labeled by UL, FM, or ETL for the intended use and shall bear their label.
 - 2. Plastic materials or equipment with plastic components cannot be installed or used in or as part of a building unless:
 - a. Such covered product complies with the requirements of Chapter 26 of the Building Code of New York State.
 - b. A report of such compliance has been filed with the Department of State in accordance with the Building Code of New York State.
- C. Before submitting bid, consult above codes, regulations, and requirements and make all necessary provisions for same in bid.

1.10 TEMPORARY FACILITIES AND CONTROLS

- A. Refer to Division 01 Specifications.
- B. Temporary Water:
 - 1. Make temporary connections for the services requiring them.
 - 2. Use piping materials for each service as called for under the Section describing that service.
 - 3. Test the installed lines.
 - 4. Provide backflow prevention on supply lines.
 - 5. Provide necessary temporary heat or heat trace cable for temporary water supplies.

1.11 PRODUCT REQUIREMENTS

- A. Refer to Division 01 Specifications.
- B. The term "product" shall mean items obtained for incorporating into the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes terms "materials," "equipment," "systems," and terms of similar intent.
- C. The Contract is based on products specified herein, shown on Drawings, and as authorized by addendum.
- D. Ensure all products conform to the Drawings and Specifications with regard to space requirements, performance, capacity, configuration, accessories, and materials of construction.
- E. Products furnished shall be new and, where used for similar purposes, of the same manufacturer. To the fullest extent possible, provide like products from a single source. If quantities from a single source cannot be provided, Architect/Engineer will make determination.
- F. Where the term "provide" is indicated, it shall have the same meaning as "furnish and install." All products listed shall be furnished and installed unless specifically noted to the contrary.
- G. Where the term "or equal" or "or approved equal" is indicated, it shall mean the same as "comparable product."

- H. Where "comparable product" is indicated, it shall mean a product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product. Contractor's request for comparable products will be considered when the following conditions are satisfied. If the following conditions are not satisfied, Engineer may return requests without action, except to record noncompliance with these requirements:
1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 3. Evidence that proposed product provides specified warranty.
 4. If requested, list of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 5. If requested, samples.
- I. Where the term "basis-of-design product," including manufacturer and model number or other designation, is indicated, intent is to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the Specifications. Bear responsibility and cost for changes made necessary by the use of products other than those of the basis-of-design product.
- J. Where the term "substitution" is indicated, it shall mean changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
1. The products described in the Contract Documents establish a standard of required function, dimensions, appearance, and quality to be met by any proposed substitution.
 2. Contractor may make substitutions only with consent of Owner, after evaluation by the Architect/Engineer and in accordance with a Change Order.
 3. Substitution Procedures:
 - a. Follow substitution procedures indicated in Division 01 Specifications.
- K. Wherever subparagraph titles below introduce lists, the following requirements apply for product selection:
1. Available Manufacturers/Available Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers or products specified.
 - a. This is a non-restricted list. For unnamed manufacturer or unnamed product, product is considered a comparable product, not a substitution, and must be demonstrated and approved through submittal process.
 2. Manufacturers/Products: Subject to compliance with requirements, provide one of the specified products or products by one of specified manufacturers.
 - a. This is a restricted list. For unnamed manufacturer or unnamed product, product is considered a substitution.
 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product listed or a comparable product by one of the listed manufacturers.
 - a. Product by one of the listed manufacturers is considered a comparable product, not a substitution, and must be demonstrated and approved through submittal process.
 - b. For unnamed manufacturer or unnamed product, product is considered a substitution.

- L. Where "Manufacturer" or "Product" is indicated with only one named manufacturer or one named product, provide the product of the named manufacturer or the listed product. Comparable products or substitutions are not permitted.
- M. Justification for acceptance or rejection of unnamed products, unnamed manufacturers, comparable products, or product substitutions will not be demonstrated by the Architect/Engineer.
- N. Delivery, Storage, and Handling:
 - 1. Deliver, store, and handle materials as recommended by the manufacturer.
 - 2. Handle and store materials in a manner which will not damage materials.
 - 3. Deliver and store materials throughout floor areas and in locations designated by Construction Manager. Provide blocking or pallets to prevent materials from becoming soiled.
 - 4. Schedule deliveries with Construction Manager prior to shipping.
 - 5. Be available at site to receive deliveries as scheduled.
 - 6. Hoist all materials as necessary to complete this Division's scope of work.
- O. Warranties:
 - 1. Refer to Sections of this Division's Specifications for specific warranties.
 - 2. Refer to Division 01 Specifications for submittal of warranties.

1.12 EXECUTION

- A. Examination of Premises and Existing Conditions:
 - 1. Examine all existing conditions affecting compliance with Drawings and Specifications by visiting site.
 - 2. Ascertain access to site, available storage, and delivery facilities.
 - 3. Verify all governing dimensions at site.
 - 4. Inspect all adjacent work.
 - 5. Verify the location, sizes, and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services; HVAC utility piping and other utilities.
 - 6. No consideration shall be given for alleged misunderstandings. Proceeding with the work indicates acceptance of existing conditions.
- B. Roughing:
 - 1. This Division's equipment shall be located generally as shown on Drawings; however, check actual field conditions to determine exact locations and avoid interference with other trades. Deviations from the Drawings proposed by this Division must be reviewed by the Construction Manager before the changes are made. Work improperly installed due to lack of construction verification shall be corrected at the expense of this Division.
 - 2. Before roughing for equipment furnished by others, obtain approved roughing drawings and exact location for each piece of equipment.
 - 3. Obtain Drawings or proper information giving final locations of all wiring, piping, ductwork, and motor and control connections.
 - 4. Unless otherwise detailed or specified:
 - a. All services shall be concealed in wall, above ceilings, etc.
 - b. Work shall be exposed only where approved by the Architect.
 - c. Notify Construction Manager and Architect if work cannot be concealed as intended.
- C. Cutting and Patching:
 - 1. Provide removals, cutting, patching, and replacement required for installation of the work in this Contract, except as noted on the Architectural (A series) Drawings.

- a. Provide patching for all existing openings caused by the removal of existing ducts, fixtures, equipment, piping, conduit, cable tray, supports, etc.
 - 2. Before proceeding, meet at Project site with parties involved in cutting and patching, including General Contractor; notify Construction Manager; review areas of potential interference and conflict; coordinate procedures; and resolve potential conflicts.
 - 3. Patch shall match existing finishes.
 - 4. Refer to Division 01 Specifications for additional requirements.
- D. Connections to Equipment Furnished by Others:
- 1. Various pieces of equipment will be furnished to the Project site and installed by other Divisions.
 - 2. Provide roughing-in and make final connections to equipment as indicated on the Drawings and/or as required.
 - 3. Before proceeding with the work, obtain full information regarding rough-in measurements, equipment layouts, elevations, trim being furnished, and other necessary data.
 - 4. Upon request, Construction Manager will provide this Division with diagrams, photographs, drawings, and/or specifications and other complete descriptive data showing all mechanical and electrical connections. Do not rough without approved layout from Construction Manager.
 - 5. Provide accessories so that connections may be made in a manner that shall meet all referenced regulations and codes.
 - 6. See appropriate Sections of this Division's Specifications for materials and methods.
- E. Adjustment of Systems:
- 1. Set aside in the cost breakdown a sum to cover work in adjusting and balancing distribution systems.
 - 2. No payment will be made for balancing until Work of this Division is completed to the satisfaction of the Owner and Construction Manager.
- F. Protection of Openings and Equipment:
- 1. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
 - 2. Protect equipment which is factory-finished using Kraft paper, cardboard, canvas, reinforced polyethylene, etc. Clean and repaint damaged factory finish, matching the original equipment finish.
 - 3. Protect all equipment openings during construction with temporary plugs, caps, or reinforced plastic.
 - 4. Adequately protect existing flooring material, door frames, stairs, wall, etc., during construction. Use any combination of materials, such as plywood, polyethylene sheeting, framing lumber, etc., so that existing finishes are protected. Repair damage to existing finishes that were not completely protected.
- G. Progress Cleaning: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1.13 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

- A. Salvage of Existing Materials: Obtain from Construction Manager a list of existing items being removed, to be delivered to on-site storage as directed. Remove from site and legally dispose of items not specifically noted on said list.

1.14 CLOSEOUT PROCEDURES

- A. After all tests are made and installations pronounced satisfactory:
 - 1. Thoroughly clean entire installation (both exposed surfaces and interiors) and leave in clean condition.
 - 2. Remove all debris caused by work.
 - 3. Promptly remove tools, surplus materials, and trailer when work is finally accepted.
- B. Repair damage to wall and to ceiling surface treatments caused by airborne dirt and debris from within ductwork systems.
- C. Lubrication:
 - 1. Prior to final inspection and in the presence of Construction Manager:
 - a. Lubricate motors and motor-driven equipment in accordance with manufacturer's recommendations.
 - b. Check for operation without objectionable noise and for correct rotational direction. If noise or vibration is transmitted to occupied portions of the building by piping, equipment, etc., make changes and additions with no cost added to the Contract.
 - c. Check motor protective devices for proper size.
 - 2. Provide neat, typewritten list of lubricant for each motor and moving parts.
 - a. Include list in operating and maintenance manual.
- D. Valve Tagging Chart:
 - a. Include list in operating and maintenance manual.
- E. Receipts for Loose Equipment:
 - 1. Prior to request for final payment:
 - a. Deliver to Construction Manager the following loose equipment:
 - 1) Loose keys on water supply stops, exterior wall hydrants, vandal-resistant-faucet aerators, and hose bibbs.
 - 2) All other necessary loose equipment for the operation of the plumbing systems.
 - b. Obtain signed receipt for delivered loose equipment.
 - 2. Include receipt in operations and maintenance manual.
- F. Refer to Division 01 Specifications for additional information on Project closeout and cleanup.

1.15 OPERATION AND MAINTENANCE DATA

- A. Submit 3 complete copies of operating and maintenance manuals for each building to the Construction Manager 60 days prior to scheduled date of substantial completion. Noncompliance or incomplete submittal will be rejected and returned for resubmittal.
 - 1. Photocopy paragraphs B and C below to be used a checklist for compliance with materials, format, and data.
 - 2. Once items are compiled, place a checkmark in the brackets for items included and strike through the items that do not apply.
 - 3. Submit checklist with operating and maintenance manuals.
- B. The operating and maintenance manuals shall consist of and will be reviewed for the following format and contents.
 - 1. Binder:
 - a. Three-ring, plain black, vinyl binder free of vendor/contractor logos, etc.
 - b. Cover and spine (binder) identification including:
 - 1) Manual title: "OPERATION AND MAINTENANCE MANUAL."
 - 2) Owner.

- 3) Project title.
- 4) Owner's project number.
- 5) Year of construction.
- 6) Trade(s).
- 7) Volume number and total number of volumes (e.g., Volume 1 of 2).

2. Contents:

- a. Project title page (enclosed in clear, transparent plastic sleeve) to match cover identification with at least one-third page blank for review stamp and comments.
- b. Project directory page (enclosed in a clear transparent plastic sleeve) including name, address, and telephone number of:
 - 1) Owner.
 - 2) Architect.
 - 3) Engineer.
 - 4) Contractor.
 - 5) Subcontractor.
- c. Table of contents (enclosed in a clear, transparent plastic sleeve) arranged to follow Specifications order (with format as list below):
 - 1) Warranty letter.
 - 2) Summary of scheduled maintenance.
 - 3) Lubrication summary.
 - 4) Valve charts.
 - 5) Replacement filter media and size summary.
 - 6) List of maintenance parts, repair/replacement parts, and recommended spare parts, including equipment name, part number, and suppliers (name, address, and phone number).
 - 7) Letters of certification for required system tests.
 - 8) Include on table of contents the following information for each product:

Spec. Section Number	Equipment Description	Supplying Company	Local Representative	Telephone Number
220500	Widgets	Acme Company	John Doe	555-1212

- d. Submittals as indicated in "Submittals" Article of this Section, including:
 - 1) Approved copies of all submittals, including parts lists.
 - 2) Material safety data sheets for:
 - a) Firestopping.
 - b) Insulations, facings, and adhesives.
 - 3) Installation, operating, and maintenance instructions.
 - 4) Wiring diagrams.
 - 5) Warranties.
 - 6) Test reports.

C. Product Identification:

- 1. Provide indexed cardstock dividers between each submittal group.
- 2. Arrange in an order corresponding to the original Project's Specifications.
- 3. Where cataloged data covers more than one item, highlight applicable sections and identify corresponding equipment as marked on Drawings.
- 4. Instructions shall include:
 - a. Time schedule for maintenance work (list each item of mechanical equipment requiring inspection, lubrication, or service) and description of the performance of such maintenance.
 - b. List of types of bearings for each piece of equipment with the type of lubricant required and frequency of lubrication.
 - c. Sequence of operating and/or flow diagrams for each of the systems, including emergency procedures.
 - d. Normal starting, operating, and shutdown procedures.

1.16 PROJECT RECORD DOCUMENTS

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Maintenance of Record Documents and Samples: Store record documents and samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Construction Manager's, Architect's, and/or Engineer's reference during normal working hours.
- C. Record Drawings:
 - 1. Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - a. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - 1) Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - 2) Accurately record information in an acceptable drawing technique.
 - 3) Record data as soon as possible after obtaining it.
 - 4) Record and check the markup before enclosing concealed installations.
 - 5) Cross-reference record prints to corresponding archive photographic documentation.
 - b. Content: Types of items requiring marking include, but are not limited to, the following:
 - 1) Dimensional changes to Drawings.
 - 2) Revisions to details shown on Drawings.
 - 3) Locations and depths of underground utilities.
 - 4) Revisions to routing of piping and conduits.
 - 5) Revisions to electrical circuitry.
 - 6) Actual equipment locations.
 - 7) Locations of concealed internal utilities.
 - 8) Locations of isolation valves, balance valves, drain valves, air vents.
 - 9) Changes made by Change Order or Construction Change Directive.
 - 10) Changes made following Architect's written orders.
 - 11) Details not on the original Contract Drawings.
 - 12) Field records for variable and concealed conditions.
 - 13) Record information on the Work that is shown only schematically.
 - c. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 - d. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 - e. Mark important additional information that was either shown schematically or omitted from original Drawings.
 - f. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

2. Submittals: Comply with the following:
 - a. Submit Record Drawings as follows:
 - 1) Initial Submittal:
 - a) Submit paper-copy of marked-up record prints to Engineer for review. Submit a copy of each drawing, whether or not changes and additional information were recorded.
 - b) Engineer will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - 2) Final Submittal:
 - a) At the end of Project and after incorporating Engineer's review comments, submit paper-copy of final marked-up record prints and PDF electronic files of scanned record prints on a digital video disk recordable (DVD-R) to Construction Manager. Print each drawing, whether or not changes and additional information were recorded.
 - b. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
 - 1) Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include the following identification on cover sheets.
 - 2) PDFs: Organize into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification (i.e., Drawing Number). Include the following identification on DVD-R.
 - 3) Identification: As follows:
 - a) Project name.
 - b) Date.
 - c) Designation "PROJECT RECORD DRAWINGS."
 - d) Name of Architect.
 - e) Name of Contractor.
- D. Record Specifications: Comply with the following:
1. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
 - a. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - b. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 - c. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 - d. Note related Change Orders, record Product Data, and record Drawings where applicable.
 2. Submittal: Submit paper copy of Record Specifications, including addenda and contract modifications, and scanned PDF electronic file(s) of marked-up paper copy of Specifications on DVD-R to Construction Manager. Identification shall be as stated hereinbefore for Record Drawings.
- E. Refer to Division 01 Specifications.

1.17 DEMONSTRATION AND TRAINING

- A. Owner's designated operating personnel shall be instructed in the care and operation of the systems in accordance with manufacturer's instructions and as indicated in these Specifications.

- B. Coordinate instruction schedule with Owner's operations. Notify Owner's personnel in advance of training. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.
- D. Training shall include, but not be limited to, the following systems:
 1. Domestic hot water system.

1.18 GENERAL COMMISSIONING REQUIREMENTS

- A. The Owner intends to engage a commissioning agent to commission the service water heating system(s) in accordance with the 2020 Energy Conservation Construction Code of New York State.
- B. Management and Coordination: Manage schedule and coordinate with commissioning agency including, but not limited to, the following:
 1. Coordinate with subcontractors their commissioning responsibilities and activities.
 2. Obtain, assemble, and submit commissioning documentation.
 3. Attend periodic on-site commissioning meetings. Assume 3one-hour-long meetings.
 4. Maintain the commissioning schedule. Integrate commissioning schedule into the construction schedule. Update schedule at specified intervals.
 5. Review and comment on preliminary test procedures and data forms.
 6. Report inconsistencies and issues with system operations.
 7. Verify that tests have been completed and results comply with acceptance criteria and that equipment and systems are ready before scheduling test demonstrations.
 8. Direct and coordinate test demonstrations.
 9. Coordinate witnessing of test demonstrations by Owner's witness.
 10. Coordinate and manage training. Be present during training sessions to direct video recording, present training, and direct the training presentations of others.
 11. Prepare and submit specified commissioning/test/start-up reports.
 12. Track commissioning issues until resolution and retesting is successfully completed.
 13. Retain original records of Commissioning-Process Work, organized as required for the commissioning report. Provide Owner with access to these records on request.
 14. Assist in assembly and submission of commissioning report.

1.19 WORK RELATED TO ASBESTOS AND WORK IN ASBESTOS-CONTAMINATED AREAS

- A. Portions of the existing mechanical systems and general construction are believed to be insulated or constructed with asbestos-containing materials.
- B. Asbestos-containing materials have reportedly contaminated portions of the crawlspace and ceiling plenum.
- C. Do not disturb such materials.
- D. Where work is unavoidable in contaminated areas, employ or subcontract the services of an "Allied Trade Certified Mechanic" (ATCM) to perform the work of this Division.
- E. It is understood that a separate contract has been, or will be, issued for the abatement of portions of the asbestos-containing materials.

PART 2 - PRODUCTS

2.1 PENETRATION FIRESTOPPING

- A. Available Manufacturers:
 - 1. A/D Fire Protection Systems Inc.
 - 2. Grace Construction Products.
 - 3. Hilti, Inc.
 - 4. Johns Manville.
 - 5. Nelson Firestop Products.
 - 6. NUCO Inc.
 - 7. Passive Fire Protection Partners.
 - 8. RectorSeal Corporation.
 - 9. Specified Technologies Inc.
 - 10. 3M Fire Protection Products.
 - 11. Tremco, Inc.; Tremco Fire Protection Systems Group.
 - 12. USG Corporation.

- B. Provide penetration firestopping materials that are compatible with one another, substrates, and penetrating items if any.

- C. Penetrations in Fire-Resistance-Rated Walls and Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
 - 1. F-Rating at Fire-Resistance-Rated Walls: Not less than that of construction penetrated.
 - 2. F-Rating at Horizontal Assemblies: At least 1 hour, but not less than that of construction penetrated.

- D. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.

PART 3 - EXECUTION

3.1 PENETRATION FIRESTOPPING

- A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

END OF SECTION

SECTION 22 05 00

COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Motors.
 2. Packless expansion joints.
 3. Alignment guides and anchors.
 4. Sleeves without waterstop.
 5. Sleeves with waterstop.
 6. Stack-sleeve fittings.
 7. Sleeve-seal systems.
 8. Grout.
 9. Silicone sealants.
 10. Escutcheons.
 11. Thermometers, bimetallic actuated, lead free.
 12. Thermometers, filled system, lead free.
 13. Thermometers, liquid in glass, lead free.
 14. Thermometers, light activated, lead free.
 15. Thermowells, lead free.
 16. Pressure gauges, dial type, lead free.
 17. Gauge attachments, lead free.
 18. Test plugs, lead free.
 19. Test-plug kits, lead free.
 20. Sight flow indicators, lead free.

1.2 DEFINITIONS

- A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 ACTION SUBMITTALS

- A. Product Data:
1. For each type of product, excluding motors which are included in Part 1 of the plumbing equipment Sections.
 - a. Include construction details, material descriptions, and dimensions of individual components, and finishes.
 - b. Include operating characteristics and furnished accessories.
- B. Delegated Design Submittals: For each anchor and alignment guide, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.
1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
- B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators in accordance with 2021 ASME Boiler and Pressure Vessel Code, Section IX.

1.6 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Domestic water for plumbing piping intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. Compatibility: Provide products suitable for piping service fluids, materials, working pressures, and temperatures.
- C. Capability: Provide products and installations to accommodate maximum axial movement as scheduled or indicated on Drawings.

2.2 SLEEVES AND SLEEVE SEALS

- A. Sleeves without Waterstop:
 - 1. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron, with plain ends.
 - 2. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.
 - 3. Steel Sheet Sleeves: ASTM A653/A653M, 24 gauge minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.
 - 4. PVC Pipe Sleeves: ASTM D1785, Schedule 40.
 - 5. Molded-PVC Sleeves: With nailing flange.
 - 6. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange.
- B. Sleeves with Waterstop:
 - 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. Advance Products & Systems, LLC.

- b. CALPICO, Inc.
 - c. GPT; a division of EnPRO Industries.
 - d. Metraflex Company (The).
 - 2. Description: Manufactured PVC/HDPE, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.
- C. Grout:
 - 1. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
 - 2. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
 - 3. Design Mix: 5000 psi, 28-day compressive strength.
 - 4. Packaging: Premixed and factory packaged.
- D. Silicone Sealants:
 - 1. Silicone Sealant, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
 - 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) GE Construction Sealants; Momentive Performance Materials Inc.
 - 2) ITW Polymers Sealants North America.
 - 3) Polymeric Systems, Inc.
 - 4) Sherwin-Williams Company (The).
 - 5) Sika Corporation.
 - 6) The Dow Chemical Company.
 - 7) Tremco Incorporated.
 - b. Standard: ASTM C920, Type S, Grade NS, Class 25, Use NT.

2.3 ESCUTCHEONS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. BrassCraft Manufacturing Co.; a Masco company.
 - 2. Dearborn Brass.
 - 3. Jones Stephens Corp.
 - 4. Keeney Manufacturing Company (The).
 - 5. Mid-America Fittings, LLC; A Midland Industries Company.
 - 6. ProFlo; a Ferguson Enterprises, Inc. brand.
- B. Escutcheon Types:
 - 1. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
 - 2. One-Piece, Stainless Steel Type: With polished stainless steel finish.
 - 3. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
 - 4. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel or brass with polished, chrome-plated finish and spring-clip fasteners.
 - 5. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
 - 6. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.
- C. Floor Plates:
 - 1. Split Floor Plates: Cast brass with concealed hinge.

2.4 METERS AND GAUGES FOR PLUMBING PIPING

- A. Thermometers, Bimetallic Actuated, Lead Free:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ashcroft Inc.
 - b. Blue Ribbon Corp.
 - c. Ernst Flow Industries.
 - d. Marsh Bellofram.
 - e. Miljoco Corporation.
 - f. Noshok.
 - g. Palmer Wahl Instrumentation Group.
 - h. REOTEMP Instrument Corporation.
 - i. Tel-Tru Manufacturing Company.
 - j. Terice, H. O. Co.
 - k. WATTS; A Watts Water Technologies Company.
 - l. WIKA Instrument Corporation.
 - m. Weiss Instruments, Inc.
 - n. Weksler Glass Thermometer Corp.
 - o. Winters Instruments - U.S.
 2. Source Limitations: Provide lead-free bimetallic-actuated thermometers from a single manufacturer.
 3. Standard: ASME B40.200.
 4. Case: Liquid-filled type(s); stainless steel with 3-inch nominal diameter.
 5. Dial: Nonreflective aluminum with permanent scale markings and scales in deg F.
 6. Connector Type(s): Union joint, adjustable angle; with ASME B1.1 or ASME B1.20.1 screw threads to fit thermowell.
 7. Stem: 0.25 or 0.375 inch in diameter; stainless steel.
 8. Window: Plain glass.
 9. Ring: Stainless steel.
 10. Element: Bimetal coil.
 11. Pointer: Dark-colored metal.
 12. Accuracy: Plus or minus 1 percent of span.
- B. Thermometers, Filled System, Lead Free - Direct Mounted, Metal Case, Vapor Actuated:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ashcroft Inc.
 - b. Miljoco Corporation.
 - c. Palmer Wahl Instrumentation Group.
 - d. REOTEMP Instrument Corporation.
 - e. Terice, H. O. Co.
 - f. Weiss Instruments, Inc.
 2. Source Limitations: Provide filled-system, lead-free, direct-mounted, metal-case, vapor-actuated thermometers from a single manufacturer.
 3. Standard: ASME B40.200.
 4. Case: Sealed type, cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
 5. Element: Lead-free Bourdon tube.
 6. Movement: Mechanical, dampening type, with link to pressure element and connection to pointer.
 7. Dial: Nonreflective aluminum with permanent scale markings graduated in deg F.
 8. Pointer: Dark-colored metal.
 9. Window: Glass.
 10. Ring: Stainless steel.
 11. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device; with ASME B1.1 or ASME B1.20.1 screw threads to fit thermowell.

12. Thermal System: Liquid-filled, mercury-free bulb in copper-plated steel, aluminum, or lead-free brass stem and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
 13. Accuracy: Plus or minus 1 percent of span.
- C. Thermometers, Liquid in Glass, Lead Free - Metal Case, Industrial Style:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Blue Ribbon Corp.
 - b. Flo Fab Inc.
 - c. Miljoco Corporation.
 - d. Palmer Wahl Instrumentation Group.
 - e. Trerice, H. O. Co.
 - f. Weiss Instruments, Inc.
 - g. Weksler Glass Thermometer Corp.
 - h. Winters Instruments - U.S.
 2. Source Limitations: Provide liquid-in-glass, lead-free, metal-case, industrial-style thermometers from single manufacturer.
 3. Standard: ASME B40.200.
 4. Case: Cast aluminum; 7-inch nominal size unless otherwise indicated.
 5. Case Form: Adjustable angle unless otherwise indicated.
 6. Tube: Glass with magnifying lens and blue or red organic liquid, mercury free.
 7. Tube Background: Nonreflective aluminum with permanent scale markings graduated in deg F.
 8. Window: Glass.
 9. Stem: Aluminum and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
 10. Connector: 1-1/4 inches, with ASME B1.1 or ASME B1.20.1 screw threads to fit thermowell.
 11. Accuracy: Plus or minus 1 percent of span or one scale division, to a maximum of 1.5 percent of span.
- D. Thermowells, Lead Free:
1. Standard: ASME B40.200.
 2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
 3. Material for Use with Copper Tubing: Lead-free copper.
 4. Material for Use with Steel Piping: Type 304 stainless steel.
 5. Type: Stepped shank unless straight or tapered shank is indicated.
 6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, or as required to match threaded opening in pipe.
 7. Internal Threads: Size and thread type as required to match thermometer mounting threads.
 8. Bore: Diameter required to match thermometer bulb or stem.
 9. Insertion Length: Length to extend to match thermometer stem length.
 10. Lagging Extension: Include on thermowells for insulated piping and tubing. Extension is to be of sufficient length to extend beyond finished insulation surface.
 11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
 12. Heat-Transfer Medium: Mixture of graphite and glycerin.
- E. Pressure Gauges, Dial Type, Lead Free - Direct Mounted, Metal Case:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ametek U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Blue Ribbon Corp.
 - d. Ernst Flow Industries.

- e. Flo Fab Inc.
 - f. Marsh Bellofram.
 - g. Miljoco Corporation.
 - h. Noshok.
 - i. Palmer Wahl Instrumentation Group.
 - j. REOTEMP Instrument Corporation.
 - k. Tel-Tru Manufacturing Company.
 - l. Trerice, H. O. Co.
 - m. WATTS; A Watts Water Technologies Company.
 - n. WIKA Instrument Corporation.
 - o. Weiss Instruments, Inc.
 - p. Weksler Glass Thermometer Corp.
 - q. Winters Instruments - U.S.
2. Source Limitations: Provide dial-type, lead-free, direct-mounted, metal-case pressure gauges from single manufacturer.
 3. Standard: ASME B40.100.
 4. Case: Sealed type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
 5. Pressure-Element Assembly: Lead-free Bourdon tube.
 6. Pressure Connection: Lead-free brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 7. Movement: Mechanical, with link to pressure element and connection to pointer.
 8. Dial: Nonreflective aluminum with permanent scale markings graduated in psi.
 9. Pointer: Dark-colored metal.
 10. Window: Glass.
 11. Ring: Metal.
 12. Accuracy: Grade A, plus or minus 1 percent of middle half of span.
- F. Gauge Attachments, Lead Free:
1. Snubbers: ASME B40.100, lead-free brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
 2. Valves: Lead-free brass or stainless steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.
- G. Test Plugs, Lead Free:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. IMI Flow Design, Inc.
 - b. Miljoco Corporation.
 - c. Nexus Valve, Inc.; Aalberts Hydronic Flow Control.
 - d. Peterson Equipment Co., Inc.
 - e. Trerice, H. O. Co.
 - f. WATTS; A Watts Water Technologies Company.
 - g. Weiss Instruments, Inc.
 - h. Weksler Glass Thermometer Corp.
 2. Source Limitations: Provide lead-free test plugs from single manufacturer.
 3. Description: Test-station fitting made for insertion into piping tee fitting.
 4. Body: Lead-free brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
 5. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.
 6. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
 7. Core Inserts: Chlorosulfonated polyethylene synthetic self-sealing rubber.
- H. Test-Plug Kits, Lead Free:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Blue Ribbon Corp.
 - b. Peterson Equipment Co., Inc.

2. Source Limitations: Provide lead-free test-plug kits from single manufacturer.
3. Furnish one test-plug kit(s) containing one thermometer(s), one pressure gauge and adapter, and carrying case. Thermometer sensing elements, pressure gauge, and adapter probes are to be of diameter to fit test plugs and of length to project into piping.
4. High-Range Thermometer, Lead Free: Small, bimetallic insertion type with 1- to 2-inch-diameter dial and tapered-end sensing element. Dial range is to be at least 0 to 220 deg F.
5. Pressure Gauge, Lead Free: Small, lead-free Bourdon-tube insertion type with 2- to 3-inch-diameter dial and probe. Dial range is to be at least 0 to 200 psig.
6. Carrying Case: Metal or plastic, with formed instrument padding.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES - GENERAL

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. Install sleeves for pipes passing through interior partitions.
 1. Cut sleeves to length for mounting flush with both surfaces.
 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants that joint sealant manufacturer's literature indicates is appropriate for size, depth, and location of joint.
- C. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 07 84 13 "Penetration Firestopping."

3.2 INSTALLATION OF SLEEVES WITH WATERSTOP

- A. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange centered across width of concrete slab or wall.
- B. Secure nailing flanges to wooden concrete forms.
- C. Using grout or silicone sealant, seal space around outside of sleeves. Select to maintain fire resistance of floor/slab/wall.

3.3 INSTALLATION OF ESCUTCHEONS

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

3.4 INSTALLATION OF METERS AND GAUGES

- A. Install thermometer with thermowell at each required thermometer location.
- B. Install thermowells in vertical position in piping tees.
- C. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

- D. Install thermowells with extension on insulated piping.
- E. Fill thermowells with heat-transfer medium.
- F. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- G. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at most readable position.
- H. Install valve and snubber in piping for each pressure gauge for fluids.
- I. Install test plugs in piping tees.
- J. Install thermometers in the following locations:
 - 1. Inlet and outlet of each water heater.
 - 2. Inlet and outlet of each domestic hot-water storage tank.
 - 3. Outlet side of hot-water-balancing valve.
- K. Install pressure gauges in the following locations:
 - 1. Suction and discharge of each domestic water pump.

3.5 CONNECTIONS

- A. Install meters and gauges adjacent to machines and equipment to allow space for service and maintenance of meters, gauges, machines, and equipment.

3.6 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gauges to proper angle for best visibility.

3.7 FIELD QUALITY CONTROL

- A. Sleeves and Sleeve Seals:
 - 1. Perform the following tests and inspections:
 - a. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
 - b. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
 - 2. Prepare test and inspection reports.
- B. Escutcheons:
 - 1. Using new materials, replace broken and damaged escutcheons and floor plates.

3.8 SLEEVES APPLICATION

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete Walls above and below Grade:
 - a. Sleeves with waterstops.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - 2. Concrete Slabs-on-Grade:
 - a. Sleeves with waterstops.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - 3. Concrete Slabs above Grade:

- a. Sleeves with waterstops.
- 4. Interior Wall and Partitions:
 - a. Sleeves without waterstops.

3.9 ESCUTCHEONS APPLICATION

- A. Escutcheons for New Piping:
 - 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - 2. Chrome-Plated Piping: One piece, steel with polished, chrome-plated finish.
 - 3. Insulated Piping:
 - a. One piece, steel with polished, chrome-plated finish.
 - 4. Bare Piping at Wall and Floor Penetrations in Finished Spaces:
 - a. One piece, steel with polished, chrome-plated finish.
 - 5. Bare Piping at Ceiling Penetrations in Finished Spaces:
 - a. One piece, steel with polished, chrome-plated finish.
 - 6. Bare Piping in Unfinished Service Spaces:
 - a. One piece, steel with polished, chrome-plated finish.
 - 7. Bare Piping in Equipment Rooms:
 - a. One piece, steel with polished, chrome-plated finish.
- B. Install floor plates for piping penetrations of equipment-room floors.
- C. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. New Piping and Relocated Existing Piping: One piece, floor plate.
 - 2. Existing Piping: Split floor plate.

3.10 THERMOMETER, LEAD FREE, APPLICATION

- A. Thermometers at inlet and outlet of each domestic water heater are to be the following:
 - 1. Liquid-filled, bimetallic-actuated type.
 - 2. Metal case, liquid-in-glass type.
- B. Thermometers at inlet and outlet of each domestic hot-water storage tank are to be the following:
 - 1. Liquid-filled, bimetallic-actuated type.
 - 2. Direct-mounted,- liquid in glass type.
- C. Thermometer stems are to be of length to match thermowell insertion length.

3.11 THERMOMETER, LEAD FREE, SCALE-RANGE APPLICATION

- A. Scale Range for Domestic Cold-Water Piping:
 - 1. 0 to 100 deg F.
- B. Scale Range for Domestic Hot-Water Piping:
 - 1. 0 to 250 deg F.

3.12 PRESSURE-GAUGE APPLICATION

- A. Pressure gauges at suction and discharge of each domestic water pump are to be the following:
 - 1. Sealed, direct mounted, metal case.

3.13 PRESSURE-GAUGE SCALE-RANGE APPLICATION

- A. Scale Range for Domestic Water Piping:
 - 1. 0 to 100 psi.

- B. Insert additional paragraphs for pressure-gauge scale ranges and applications.

END OF SECTION

SECTION 22 05 23.12

BALL VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Brass ball valves.
 - 2. Bronze ball valves.

1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. RPTFE: Reinforced polytetrafluoroethylene.
- C. WOG: Water, oil, gas.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Brass ball valves.
 - 2. Bronze ball valves.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, and soldered ends.
 - 3. Set ball valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of valve from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Standards:
 - 1. Domestic water valves intended to convey or dispense water for human consumption must comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or must be certified to be in compliance with NSF 61 and NSF 372 (by an ANSI-accredited third-party certification body) that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

- B. ASME Compliance:
 - 1. ASME B1.20.1 for threads for threaded end valves.
 - 2. ASME B16.18 for cast copper solder-joint connections.
 - 3. ASME B16.22 for wrought copper and copper alloy solder-joint connections.
 - 4. ASME B16.34 for flanged and threaded end connections
 - 5. ASME B31.9 for building services piping valves.
- C. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- D. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- E. Valve Sizes: Same as upstream piping unless otherwise indicated.
- F. Valve Actuator Type:
 - 1. Hand Lever: For quarter-turn valves smaller than NPS 4.
- G. Valves in Insulated Piping:
 - 1. Provide 2-inch extended neck stems.
 - 2. Extended operating handles with nonthermal-conductive covering material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
 - 3. Memory stops that are fully adjustable after insulation is applied.

2.3 BRASS BALL VALVES

- A. Brass Ball Valves, Two Piece with Full Port and Stainless Steel Trim, Threaded or Soldered Ends:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A.Y. McDonald Mfg. Co.
 - b. American Valve, Inc.
 - c. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - d. Hammond Valve.
 - e. Jenkins Valves; a Crane Co. brand.
 - f. Jomar Valve.
 - g. KITZ Corporation.
 - h. Lance Valves.
 - i. Marwin Valve; Richards Industries.
 - j. Milwaukee Valve Company.
 - k. Red-White Valve Corp.
 - l. Stockham; a Crane Co. brand.
 - m. Viega LLC.
 - n. WATTS; A Watts Water Technologies Company.
 - 2. Standard: MSS SP-110; MSS SP-145.
 - 3. CWP Rating: 600 psig.
 - 4. Body Design: Two piece.
 - 5. Body Material: Forged brass.
 - 6. Ends: Threaded or soldered.
 - 7. Seats: PTFE.
 - 8. Stem: Stainless steel.
 - 9. Ball: Stainless steel, vented.
 - 10. Port: Full.
- B. Brass Ball Valves, Two Piece with Full Port and Stainless Steel Trim, Press Ends:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.

- b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
- c. Center Line; a Crane Co. brand.
- d. Hammond Valve.
- e. Jomar Valve.
- f. Lance Valves.
- g. Milwaukee Valve Company.
- h. NIBCO INC.
- i. Red-White Valve Corp.
- j. Stockham; a Crane Co. brand.
- k. Viega LLC.
- l. WATTS; A Watts Water Technologies Company.
- 2. Standard: MSS SP-110; MSS SP-145; IAPMO/ANSI Z1157.
- 3. CWP Rating: Minimum 200 psig.
- 4. Body Design: Two piece.
- 5. Body Material: Forged brass.
- 6. Ends: Press.
- 7. Press-End Connections Rating: Minimum 200 psig.
- 8. Seats: PTFE or RPTFE.
- 9. Stem: Stainless steel.
- 10. Ball: Stainless steel, vented.
- 11. Port: Full.
- 12. O-Ring Seal: Buna-N or EPDM.

2.4 BRONZE BALL VALVES

- A. Bronze Ball Valves, Two Piece with Full Port and Stainless Steel Trim, Threaded or Soldered Ends:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. Center Line; a Crane Co. brand.
 - c. DynaQuip Controls.
 - d. Hammond Valve.
 - e. Jenkins Valves; a Crane Co. brand.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corp.
 - i. Stockham; a Crane Co. brand.
 - j. Viega LLC.
 - k. WATTS; A Watts Water Technologies Company.
 - 2. Standard: MSS SP-110; MSS SP-145.
 - 3. CWP Rating: 600 psig.
 - 4. Body Design: Two piece.
 - 5. Body Material: Bronze.
 - 6. Ends: Threaded or soldered.
 - 7. Seats: PTFE.
 - 8. Stem: Stainless steel.
 - 9. Ball: Stainless steel, vented.
 - 10. Port: Full.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves. Remove defective valves from site.

3.2 INSTALLATION OF VALVES

- A. Install valves with unions or flanges at each piece of equipment arranged to allow space for service, maintenance, and equipment removal without system shutdown.
- B. Provide support to piping adjacent to valves such that no force is imposed upon valves.
- C. Locate valves for easy access.
- D. For valves in horizontal piping, install valves with stem at or above center of pipe.
- E. Install valves in position to allow full valve actuation movement.
- F. Valve Tags: Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
- G. Adhere to manufacturer's written installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's recommended maximum.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves exhibiting leakage.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified CWP ratings are unavailable, provide the same types of valves with higher CWP ratings.
- B. Select valves with the following end connections:
 1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
 2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 (DN 50) and Smaller:
 1. Brass ball valves, two piece with full port, and stainless steel trim. Provide with threaded solder or press-connection-joint ends.
 2. Bronze ball valves, two piece with full port, and stainless steel trim. Provide with threaded solder or press-connection-joint ends.

END OF SECTION

SECTION 22 05 23.14

CHECK VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Bronze, swing check valves.

1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene-diene terpolymer.
- C. NBR: Nitrile butadiene rubber (also known as Buna-N).

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Bronze, swing check valves.
 - 2. Bronze, swing check valves, press ends.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, press connections, and weld ends.
 - 3. Set check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use stems or other components as lifting or rigging points unless specifically indicated for this purpose in manufacturer's instructions.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of valve from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Standards:
 - 1. Domestic water piping check valves intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), requirements of authorities having jurisdiction, and NSF 61/NSF 372, or to be certified in compliance with NSF 61/NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the

weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

- B. ASME Compliance:
 - 1. ASME B1.20.1 for threads for threaded end valves.
 - 2. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 3. ASME B16.18 for cast-copper solder joint.
 - 4. ASME B16.22 for wrought copper solder joint.
 - 5. ASME B16.51 for press joint.
 - 6. ASME B31.9 for building services piping valves.
- C. AWWA Compliance: Comply with AWWA C606 for groove-end connections.
- D. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are unacceptable.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Bypass and Drain Connections: MSS SP-45.

2.3 BRONZE, SWING CHECK VALVES

- A. Bronze, Swing Check Valves with Bronze Disc, Class 150:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A.Y. McDonald Mfg. Co.
 - b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - c. Crane Fluid Systems; Crane Co.
 - d. Hammond Valve.
 - e. Jenkins Valves; a Crane Co. brand.
 - f. Jomar Valve.
 - g. Lance Valves.
 - h. Milwaukee Valve Company.
 - i. NIBCO INC.
 - j. Powell Valves.
 - k. Red-White Valve Corp.
 - l. Stockham; a Crane Co. brand.
 - 2. Standard: MSS SP-80, Type 3.
 - 3. CWP Rating: 300 psig.
 - 4. Body Design: Horizontal flow.
 - 5. Body Material: ASTM B62, bronze.
 - 6. Ends: Threaded or soldered. See valve schedule articles.
 - 7. Disc: Bronze.
- B. Bronze, Swing Check Valves, Press Ends:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. Crane Fluid Systems; Crane Co.
 - c. Elkhart Products Corporation; a part of Aalberts Integrated Piping Systems.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - 2. Standard: MSS SP-80 and MSS SP-139.

3. CWP Rating: Minimum 200 psig.
4. Body Design: Horizontal flow.
5. Body Material: ASTM B584, bronze.
6. Ends: Press.
7. Press Ends Connection Rating: Minimum 200 psig.
8. Disc: Brass or bronze.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Examine press fittings to verify they have been properly pressed.
- F. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION OF VALVES

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Provide support of piping adjacent to valves such that no force is imposed upon valves.
- C. Locate valves for easy access and where not blocked by equipment, other piping, or building components.
- D. Install valves so that stems are horizontal or slope upward from centerline of pipe.
- E. Install valves in position that does not project into aisles or block access to other equipment.
- F. Install valves in position to allow full stem and manual operator movement.
- G. Verify that joints of each valve have been properly installed and sealed to assure there is no leakage or damage.
- H. Check Valves: Install check valves for proper direction of flow.
 1. Swing Check Valves: In horizontal position with hinge pin level.
 2. Check Valves: Center-guided type and plate type, in horizontal or vertical position, between flanges.
- I. Install valve tags. Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

- J. Adhere to manufacturer's installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's recommended maximum.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- B. End Connections:
 - 1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded, soldered, or press-end connections.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flange or threaded.

3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 (DN 50) and Smaller:
 - 1. Bronze, swing check valves with bronze disc, Class 150, with soldered or threaded end connections.
 - 2. Bronze, swing check valves with press-end connections.

END OF SECTION

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Thermal hanger-shield inserts.
 - 4. Fastener systems.
 - 5. Pipe stands.
 - 6. Pipe-positioning systems.

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pregalvanized, , or electro-galvanized.
 - 3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
 - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Copper Pipe and Tube Hangers:
 - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
 - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL HANGER-SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Buckaroos, Inc.
 - 2. CADDY; brand of nVent Electrical plc.
 - 3. Carpenter & Paterson, Inc.
 - 4. National Pipe Hanger Corporation.
 - 5. Pipe Shields Inc.
 - 6. Piping Technology & Products, Inc.
 - 7. Rilco Manufacturing Co., Inc.
 - 8. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: ASTM C552, Type II cellular glass with 100-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - c. MKT Fastening, LLC.
- B. Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper B-line; brand of Eaton, Electrical Sector.
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - e. MKT Fastening, LLC.
 - 2. Indoor Applications: Zinc-coated or stainless steel.
 - 3. Outdoor Applications: Stainless steel.

2.5 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand:
 - 1. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
 3. Hardware: Galvanized steel or polycarbonate.
 4. Accessories: Protection pads.
- C. Low-Profile, Single-Base, Single-Pipe Stand:
1. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.
 2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
 3. Vertical Members: Two stainless-steel, continuous-thread, 1/2-inch rods.
 4. Horizontal Member: Adjustable horizontal, stainless-steel pipe support channels.
 5. Pipe Supports: Roller.
 6. Hardware: Stainless steel.
 7. Accessories: Protection pads.
 8. Height: 12 inches above roof.

2.6 PIPE-POSITIONING SYSTEMS

- A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with requirements in Section 22 00 10 "General Requirements for Plumbing for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
 2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:
1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

- E. Pipe Stand Installation:
 - 1. Pipe Stand Types, except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
- F. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- M. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. MSS SP-58, Type 39: Install protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. MSS SP-58, Type 40: Install protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches long and 0.048 inch thick.
 - b. NPS 4 (DN 100): 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches long and 0.105 inch thick.
 - 5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.

6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.3 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.4 PAINTING

- A. Touchup:
 1. Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - a. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
 2. Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 09 91 23 "Interior Painting."
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.5 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal hanger-shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.

4. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
 6. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 7. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 9. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
 10. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 11. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 12. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 13. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 14. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
 2. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 3. C-Clamps (MSS Type 23): For structural shapes.
 4. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 5. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 6. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 7. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 8. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

- a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
- 1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 - 3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.
- N. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- O. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- P. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Pipe labels.
 - 3. Valve tags.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve-numbering scheme.
- E. Valve Schedules: For each piping system. Include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Material and Thickness: stainless steel, 0.025-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
 - 2. Letter and Background Color: As indicated for specific application under Part 3.
 - 3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 4. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 5. Fasteners: Stainless steel rivets or self-tapping screws.
 - 6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

2.2 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- B. Letter and Background Color: As indicated for specific application under Part 3.

- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:
 - 1. Pipe size.
 - 2. Flow-Direction Arrows: Include flow-direction arrows on distribution piping. Arrows may be either integral with label or applied separately.
 - 3. Lettering Size: Size letters in accordance with ASME A13.1 for piping.

2.3 VALVE TAGS

- A. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.04-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass link chain or beaded chain.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Include valve-tag schedule in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION, GENERAL REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

- A. Permanently fasten labels on each item of plumbing equipment.
- B. Sign and Label Colors.
 - 1. White letters on an ANSI Z535.1 safety-green background.
- C. Locate equipment labels where accessible and visible.

3.4 INSTALLATION OF PIPE LABELS

- A. Install pipe labels showing service and flow direction with permanent adhesive on pipes.

- B. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Within 2 ft. of each valve and control device.
 - 2. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 3. Within 3 ft. of equipment items and other points of origination and termination.
 - 4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping and equipment.
- C. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.
- D. Flow-Direction Flow Arrows: Use arrows, in compliance with ASME A13.1, to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- E. Pipe-Label Color Schedule:
 - 1. Domestic Cold-Water Piping: White letters on an ANSI Z535.1 safety-green background.
 - 2. Domestic Hot-Water Piping: White letters on an ANSI Z535.1 safety-green background
 - 3. Domestic Hot-Water Return Piping White letters on an ANSI Z535.1 safety-green background.
 - 4. Sanitary Waste and Storm Drainage Piping: White letters on a black background.
 - 5. .Natural Gas Piping: White Letters on an ANSI Z535.1 safety yellow.

3.5 INSTALLATION OF VALVE TAGS

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule in the operating and maintenance manual.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:
 - 1. Valve-Tag Size and Shape:
 - a. Domestic Cold Water: 2 inches, round.
 - b. Domestic Hot Water: 2 inches, round.
 - c. Domestic Hot-Water Return: 2 inches, .
 - 2. Valve-Tag Colors:
 - a. For each piping system, use the same lettering and background coloring system on valve tags as used in the piping system labels and background.

END OF SECTION

SECTION 22 07 19

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following plumbing piping services:
 - 1. Domestic cold-water piping.
 - 2. Domestic hot-water piping.
 - 3. Domestic recirculating hot-water piping.
 - 4. Supplies and drains for handicap-accessible lavatories and sinks.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 6. Detail application of field-applied jackets.
 - 7. Detail application at linkages of control devices.
- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
 - 1. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
 - 2. Jacket Materials for Pipe: 12 inches long by NPS 2.
 - 3. Sheet Jacket Materials: 12 inches square.
 - 4. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

- B. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation system materials are to be delivered to the Project site in unopened containers. The packaging is to include name of the manufacturer, fabricator, type, description, and size, as well as ASTM standard designation and maximum use temperature.

1.6 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
 - 1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

- A. Products do not contain asbestos, lead, mercury, or mercury compounds.
- B. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.
 - 1. Preformed Pipe Insulation, Type II, Class 2: With factory-applied ASJ jacket.
 - 2. Fabricated shapes in accordance with ASTM C450, ASTM C585, and ASTM C1639.
 - 3. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- C. Flexible Elastomeric: Closed-cell or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534/C534M, Type I for tubular materials.

2.3 INSULATING CEMENTS

- A. Glass-Fiber and Mineral Wool Insulating Cement: Comply with ASTM C195.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C196.
- C. Glass-Fiber and Mineral Wool Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.

2.4 ADHESIVES

- A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
 - 1. For indoor applications, adhesive shall have a VOC content of 50g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Flexible Elastomeric Adhesive: Solvent-based adhesive.
 - 1. For indoor applications, adhesive shall have a VOC content of 50g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.
 - 1. For indoor applications, adhesive shall have a VOC content of 50g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. For indoor applications, adhesive shall have a VOC content of 50g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 MASTICS AND COATINGS

- A. Materials are compatible with insulation materials, jackets, and substrates.
 - 1. For indoor applications, adhesive shall have a VOC content of 50g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.
 - 1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
 - 2. Service Temperature Range: 0 to plus 180 deg F.
 - 3. Comply with MIL-PRF-19565C, Type II, for permeance requirements.

2.6 LAGGING ADHESIVES

- A. Adhesives comply with MIL-A-3316C, Class I, Grade A, and are compatible with insulation materials, jackets, and substrates.
 - 1. For indoor applications, adhesive shall have a VOC content of 50g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
 - 3. Service Temperature Range: 20 to plus 180 deg F.
 - 4. Color: White.

2.7 SEALANTS

- A. Materials are as recommended by the insulation manufacturer and are compatible with insulation materials, jackets, and substrates.

- B. Joint Sealants:
 1. Permanently flexible, elastomeric sealant.
 2. Service Temperature Range: Minus 100 to plus 300 deg F.
 3. Color: White or gray.
 4. For indoor applications, adhesive shall have a VOC content of 50g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- C. FSK and Metal Jacket Flashing Sealants:
 1. Fire- and water-resistant, flexible, elastomeric sealant.
 2. Service Temperature Range: Minus 40 to plus 250 deg F.
 3. Color: Aluminum.
 4. For indoor applications, adhesive shall have a VOC content of 50g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- D. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:
 1. Fire- and water-resistant, flexible, elastomeric sealant.
 2. Service Temperature Range: Minus 40 to plus 250 deg F.
 3. Color: White.
 4. For indoor applications, adhesive shall have a VOC content of 50g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.8 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.

2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
 1. Width: 3 inches.
 2. Thickness: 11.5 mils.
 3. Adhesion: 90 ounces force/inch in width.
 4. Elongation: 2 percent.
 5. Tensile Strength: 40 lbf/inch in width.
 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
 1. Width: 2 inches.
 2. Thickness: 6 mils.
 3. Adhesion: 64 ounces force/inch in width.
 4. Elongation: 500 percent.
 5. Tensile Strength: 18 lbf/inch in width.

2.10 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers,:
 1. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

- B. Protective Shielding Piping Enclosures:
 - 1. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.
- D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
 3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles below.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered or routed fittings made from same material and density as that of adjacent pipe insulation. Each piece is butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation conforms to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install sections of pipe insulation and miter if required in accordance with manufacturer's written instructions.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

- D. Insulation Installation on Valves and Pipe Specialties:
1. Install prefabricated valve covers manufactured of same material as that of pipe insulation when available.
 2. When prefabricated valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Install insulation to flanges as specified for flange insulation application.
 4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF MINERAL WOOL INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
 4. For insulation with jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
1. Install prefabricated pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with glass-fiber or mineral-wool blanket insulation.
 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
 2. When prefabricated insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
 2. When prefabricated sections are not available, install fabricated sections of pipe insulation to valve body.
 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 4. Install insulation to flanges as specified for flange insulation application.

3.8 INSTALLATION OF FIELD-APPLIED JACKETS

- A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.9 FINISHES

- A. Insulation with ASJ, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless steel jackets.

3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection is limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.11 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.12 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Hot, Hot Water Return and Cold Water:
 - 1. NPS 1 and Smaller: Insulation is one of the following:
 - a. Cellular Glass: 1[inches thick.
 - b. Flexible Elastomeric: 1 inch thick.
 - c. Preformed Pipe Insulation, Type II: 1 inch thick.
 - 2. NPS 1-1/4 and Larger: Insulation is one of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Flexible Elastomeric: 1 inch thick.
 - c. Preformed Pipe Insulation, Type II: 1 inch thick.

- B. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
1. All Pipe Sizes: Insulation is one of the following:
 - a. Flexible Elastomeric: 1/2 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

END OF SECTION

SECTION 22 08 00

COMMISSIONING OF PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes Cx process requirements for the following plumbing systems, assemblies, and equipment:
 - 1. Domestic hot- and cold-water piping.
 - 2. Plumbing pumps.
 - 3. Plumbing equipment.
- B. Related Requirements:
 - 1. Section 01 91 13 "General Commissioning Requirements" for general Cx process requirements and CxA responsibilities.
 - 2. For construction checklists, comply with requirements in various Division 22 Sections specifying plumbing systems, system components, equipment, and products.

1.2 DEFINITIONS

- A. Cx: Commissioning, as defined in Section 01 91 13 "General Commissioning Requirements."
- B. CxA: Commissioning Authority, as defined in Section 01 91 13 "General Commissioning Requirements."
- C. IAPMO: International Association of Plumbing and Mechanical Officials.
- D. IgCC: International Green Construction Code.
- E. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For plumbing testing technician.
- B. Construction Checklists:
 - 1. Draft Cx plan, including draft construction checklists to be prepared by CxA under Section 01 91 13 "General Commissioning Requirements." Contractor is to review Construction Checklist in accordance with requirements in Section 01 91 13 "General Commissioning Requirements" and ASHRAE 202 and to resolve any issues with the CxA.
- C. Test Equipment and Instruments: For all test equipment and instruments to be used in conducting Cx tests by Contractor, provide the following:
 - 1. Equipment/instrument identification number.
 - 2. Planned Cx application or use.
 - 3. Manufacturer, make, model, and serial number.
 - 4. Calibration history, including certificates from agencies that calibrate the equipment and instrumentation.
 - 5. Equipment manufacturers' proprietary instrumentation and tools. For each instrument or tool, identify the following:

- a. Instrument or tool identification number.
- b. Equipment schedule designation of equipment for which the instrument or tool is required.
- c. Manufacturer, make, model, and serial number.
- d. Calibration history, including certificates from agencies that calibrate the instrument or tool, where appropriate.

1.4 QUALITY ASSURANCE

- A. Plumbing Testing Technician Qualifications: Technicians to perform plumbing Construction Checklist verification tests. Construction Checklist verification test demonstrations, Cx tests, and Cx test demonstrations shall have the following minimum qualifications:
 1. Journey level or equivalent skill level with knowledge of plumbing system, electrical concepts, and building operations.
 2. Minimum three years' experience installing, servicing, and operating systems manufactured by approved manufacturer.
- B. Testing Equipment and Instrumentation Quality and Calibration:
 1. Capable of testing and measuring performance within the specified acceptance criteria.
 2. Be calibrated at manufacturer's recommended intervals with current calibration tags permanently affixed to the instrument being used.
 3. Be maintained in good repair and operating condition throughout duration of use on Project.
 4. Be recalibrated/repared if dropped or damaged in any way since last calibrated.
- C. Proprietary Test Instrumentation and Tools:
 1. Equipment Manufacturer's Proprietary Instrumentation and Tools: For installed equipment included in the Cx process, test instrumentation and tools manufactured or prescribed by equipment manufacturer to service, calibrate, adjust, repair, or otherwise work on its equipment or required as a condition of equipment warranty, shall comply with the following:
 - a. Be calibrated by manufacturer with current calibration tags permanently affixed.
 - b. Include a separate list of proprietary test instrumentation and tools in operation and maintenance manuals.
 - c. Plumbing system proprietary test instrumentation and tools become property of Owner at the time of Substantial Completion.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 Cx PROCESS

- A. Perform Cx process for plumbing systems in accordance with:
 1. Commissioning standards acceptable to the authority having jurisdiction.

3.2 Cx TESTING PREPARATION

- A. Certify that plumbing systems, subsystems, and equipment have been installed, calibrated, and started and that they are operating in accordance with the Contract Documents and approved submittals.
- B. Certify that plumbing system instrumentation and control systems have been completed and calibrated, point-to-point checkout has been successfully completed, and systems are operating in accordance with their design sequence of operation, Contract Documents, and approved submittals. Certify that all sensors are operating within

specified accuracy and that all systems are set to and maintaining set points as required by the design documents.

- C. Set systems, subsystems, and equipment into operating mode to be tested in accordance with approved test procedures (for example, normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

3.3 Cx TEST CONDITIONS

- A. Perform tests using design conditions, whenever possible.
 - 1. Simulated conditions may, with approval of Architect, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by CxA, and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.
 - 2. Cx test procedures may direct that set points be altered when simulating conditions is impractical.
 - 3. Cx test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.
- B. If tests cannot be completed because of a deficiency outside the scope of the plumbing system, document the deficiency and report it to Architect. After deficiencies are resolved, reschedule tests.
- C. If seasonal testing is specified, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.4 Cx TESTS COMMON TO PLUMBING SYSTEMS

- A. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions, to verify compliance with acceptance criteria.
- B. Test systems, assemblies, subsystems, equipment, and components for operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and response compared to acceptance criteria.
- C. Coordinate schedule with, and perform Cx activities at the direction of, CxA.
- D. Comply with Construction Checklist requirements, including material verification, installation checks, startup, and performance test requirements specified in Division 22 Sections specifying plumbing systems and equipment.
- E. Provide technicians, instrumentation, tools, and equipment to perform and document the following:
 - 1. Cx Construction Checklist verification tests.
 - 2. Cx Construction Checklist verification test demonstrations.

END OF SECTION

SECTION 22 11 16

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Copper tube and fittings - domestic water.
 - 2. Piping joining materials - domestic water.
 - 3. Transition fittings - domestic water.
 - 4. Dielectric fittings - domestic water.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Copper tube and fittings - domestic water.
 - 2. Piping joining materials - domestic water.
 - 3. Transition fittings - domestic water.
 - 4. Dielectric fittings - domestic water.

1.3 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Installers of pressure-sealed joints are to be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

1.5 FIELD CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service in accordance with requirements indicated:
 - 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of water service.
 - 2. Do not interrupt water service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Domestic water piping, tubing, fittings, joints, and appurtenances intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PIPING MATERIALS

- A. Potable-water piping and components are to comply with NSF 14, NSF 61, and NSF 372. Include marking "NSF-pw" on piping.

2.3 COPPER TUBE AND FITTINGS - DOMESTIC WATER

- A. Drawn-Temper Copper Tube: ASTM B88, Type K .
- B. Annealed-Temper Copper Tube: ASTM B88, Type K.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Do not use solder joints on pipe sizes greater than NPS 4.
- F. Cast Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends. Do not use solder joints on pipe sizes greater than NPS 4.
- G. Wrought Copper Unions: ASME B16.22. Do not use solder joints on pipe sizes greater than NPS 4.
- H. Pressure-Seal-Joint Fittings, Copper or Bronze - Domestic Water:
 - 1. Source Limitations: Obtain pressure-seal-joint fittings, copper or bronze, from single manufacturer.
 - 2. Housing: Copper.
 - 3. O-Rings and Pipe Stops: EPDM.
 - 4. Tools: Manufacturer's special tools.
 - 5. Minimum 200 psig working-pressure rating at 250 deg F.

2.4 PIPING JOINING MATERIALS - DOMESTIC WATER

- A. Pipe-Flange Gasket Materials:
 - 1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
 - 2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B32, lead-free alloys.
- D. Flux: ASTM B813, water flushable.
- E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.5 DIELECTRIC FITTINGS - DOMESTIC WATER

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

- B. Dielectric Unions - Domestic Water:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A.Y. McDonald Mfg. Co.
 - b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - c. HART Industrial Unions, LLC.
 - d. Jomar Valve.
 - e. Matco-Norca.
 - f. WATTS; A Watts Water Technologies Company.
 - g. Zurn Industries, LLC.
 - 2. Source Limitations: Obtain dielectric unions from single manufacturer.
 - 3. Standard: ASSE 1079.
 - 4. Pressure Rating: 125 psig minimum at 180 deg F.
 - 5. End Connections: Solder-joint copper alloy and threaded ferrous.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Under-building-slab, domestic water piping, NPS 2 (DN 50) and smaller is to be the following:
 - 1. Drawn-temper or annealed-temper copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and brazed copper pressure-seal-joint fittings; and pressure-sealed joints.
- D. Aboveground domestic water piping, NPS 2 (DN 50) and smaller is to be the following:
 - 1. Drawn-temper copper tube, ASTM B88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.
 - 2. Drawn-temper copper tube, ASTM B88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
- E. Aboveground domestic water piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100) is to be the following:
 - 1. Drawn-temper copper tube, ASTM B88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.
 - 2. Drawn-temper copper tube, ASTM B88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.

3.2 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab in accordance with CDA's "Copper Tube Handbook."
- C. Install valves in accordance with the following:
 - 1. Section 22 05 23.12 "Ball Valves for Plumbing Piping."
 - 2. Section 22 05 23.14 "Check Valves for Plumbing Piping."
- D. Install domestic water piping level without pitch and plumb.

- E. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- F. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- H. Install piping to permit valve servicing.
- I. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- J. Install piping free of sags and bends.
- K. Install fittings for changes in direction and branch connections.
- L. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- M. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 22 11 23.21 "Inline, Domestic Water Pumps."
- N. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 22 05 00 "Common Work Results for Plumbing."
- O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 00 "Common Work Results for Plumbing."
- P. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 00 "Common Work Results for Plumbing."
- Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 00 "Common Work Results for Plumbing."

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 1. Apply appropriate tape or thread compound to external pipe threads.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.

- E. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings in accordance with ASTM B828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.
- G. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 INSTALLATION OF DIELECTRIC FITTINGS

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric couplings or nipples.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for hangers, supports, and anchor devices in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Install hangers for copper pipe, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Support horizontal piping within 12 inches of each fitting.
- D. Support vertical runs of copper pipe to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 PIPING CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
 - 3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.7 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.8 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system in accordance with either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.9 ADJUSTING

- A. Perform the following adjustments before operation:
 - 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open shutoff valves to fully open position.
 - 3. Open throttling valves to proper setting.
 - 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 - 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 - 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 - 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 - 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.10 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after installation and before setting fixtures.

- 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
 - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
2. Piping Tests:
- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
 - f. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION

SECTION 22 11 19

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Balancing valves.
 - 2. Temperature-actuated, water mixing valves.
 - 3. Strainers for domestic water piping.
 - 4. Drain valves.
 - 5. Water-hammer arresters.
- B. Related Requirements:
 - 1. Section 22 05 00 "Common Work Results for Plumbing."
 - 2. Section 22 11 16 "Domestic Water Piping" for water meters.
 - 3. Section 22 47 16 "Pressure Water Coolers" for water filters for water coolers.

1.2 DEFINITIONS

- A. AMI: Advanced Metering Infrastructure.
- B. AMR: Automatic Meter Reading.
- C. FKM: A family of fluoroelastomer materials defined by ASTM D1418.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For domestic water piping specialties.
 - 1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Test and inspection reports.
- B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Domestic water piping specialties intended to convey or dispense water for human consumption are to comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or to be certified in compliance with NSF 61 and NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 TEMPERATURE-ACTUATED, WATER MIXING VALVES

- A. Primary, Thermostatic, Water Mixing Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company; a Division of Morris Group International.
 - b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - c. Caleffi North America.
 - d. Lawler Manufacturing Company, Inc.
 - e. POWERS; A WATTS Brand.
 - f. Symmons Industries, Inc.
 - g. WATTS; A Watts Water Technologies Company.
 - h. Zurn Industries, LLC.
 - 2. Standard: ASSE 1017.
 - 3. Pressure Rating: 125 psig minimum unless otherwise indicated.
 - 4. Type: Exposed-mounted, thermostatically controlled, water mixing valve.
 - 5. Material: Bronze body with corrosion-resistant interior components.
 - 6. Connections: Threaded union inlets and outlet.
 - 7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
 - 8. Tempered-Water Setting: Refer to Drawings. .
 - 9. Tempered-Water Design Flow Rate: Refer to Drawings. .
 - 10. Selected Valve Flow Rate at 45-psig (310-kPa) Pressure Drop: Refer to Drawings. .
 - 11. Pressure Drop at Design Flow Rate: Refer to Drawings. .
- B. Individual-Fixture, Water Tempering Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company; a Division of Morris Group International.
 - b. Caleffi North America.
 - c. Lawler Manufacturing Company, Inc.
 - d. POWERS; A WATTS Brand.
 - e. Zurn Industries, LLC.
 - 2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
 - 3. Pressure Rating: 125 psig minimum unless otherwise indicated.
 - 4. Material: Bronze body with corrosion-resistant interior components.
 - 5. Temperature Control: Adjustable.
 - 6. Connections: Threaded inlets and outlet.
 - 7. Finish: Chrome plated.
 - 8. Tempered-Water Setting: 95 F.
 - 9. Tempered-Water Design Flow Rate: ..5 gpm

2.4 STRAINERS FOR DOMESTIC WATER PIPING

- A. Y-Pattern Strainers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Keckley Company.
 - b. Titan Flow Control, Inc.
 - c. WATTS; A Watts Water Technologies Company.
 - d. Zurn Industries, LLC.
 - 2. Pressure Rating: 125 psig minimum unless otherwise indicated.

3. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
4. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
5. Screen: Stainless steel with round perforations unless otherwise indicated.
6. Perforation Size:
 - a. Strainers NPS 2 (DN 50) and Smaller: 0.033 inch.

2.5 DRAIN VALVES

- A. Ball-Valve-Type, Hose-End Drain Valves:
 1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
 2. Pressure Rating: 400-psig minimum CWP.
 3. Size: NPS 3/4.
 4. Body: Copper alloy.
 5. Ball: Chrome-plated brass.
 6. Seats and Seals: Replaceable.
 7. Handle: Vinyl-covered steel.
 8. Inlet: Threaded or solder joint.
 9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.6 WATER-HAMMER ARRESTERS

- A. Water-Hammer Arresters:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Jay R. Smith Mfg Co; a division of Morris Group International.
 - c. MIFAB, Inc.
 - d. Precision Plumbing Products.
 - e. ProFlo; a Ferguson Enterprises, Inc. brand.
 - f. Sioux Chief Manufacturing Company, Inc.
 - g. WATTS; A Watts Water Technologies Company.
 - h. Zurn Industries, LLC.
 2. Standard: ASSE 1010 or PDI-WH 201.
 3. Type: Piston.
 4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

- A. Water Control Valves: Install with inlet and outlet shutoff valves. Install pressure gauges on inlet and outlet.
- B. Balancing Valves: Install in locations where they can easily be adjusted. Set at indicated design flow rates.
- C. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.
- D. Y-Pattern Strainers: For water, install on supply side of each control valve and pump.
- E. Water-Hammer Arresters: Install in water piping in accordance with PDI-WH 201.

3.2 PIPING CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

3.3 IDENTIFICATION

- A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Balancing valves.
 - 2. Temperature-actuated, water mixing valves.

3.4 ADJUSTING

- A. Set field-adjustable flow set points of balancing valves.
- B. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION

SECTION 22 13 16

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Hub-and-spigot, cast-iron soil pipe and fittings.
 - 2. Hubless, cast-iron soil pipe and fittings.
 - 3. PVC pipe and fittings.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Hub-and-spigot, cast-iron soil pipe and fittings.
 - 2. Hubless, cast-iron soil pipe and fittings.
 - 3. Specialty pipe fittings.

1.3 FIELD CONDITIONS

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service in accordance with requirements indicated:
 - 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of sanitary waste service.
 - 2. Do not proceed with interruption of sanitary waste service without Construction Manager's written permission.

1.4 WARRANTY

- A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation are capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10 ft. head of water.

2.2 PIPING MATERIALS

- A. Piping materials to bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS (BELOW SLAB)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AB & I Foundry; a part of the McWane family of companies.
 - 2. Charlotte Pipe and Foundry Company.

3. Tyler Pipe; a part of McWane family of companies.
- B. Pipe and Fittings:
1. Marked with CISPI collective trademark.
 2. ASTM A74, service cast iron.
- C. Gaskets: ASTM C564, rubber.
- D. Caulking Materials: ASTM B29, pure lead and oakum or hemp fiber.

2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AB & I Foundry; a part of the McWane family of companies.
 2. Charlotte Pipe and Foundry Company.
 3. Tyler Pipe; a part of McWane family of companies.
- B. Pipe and Fittings:
1. Marked with CISPI collective trademark.
 2. ASTM A888 or CISPI 301.
- C. CISPI, Hubless-Piping Couplings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO-Husky.
 - b. Charlotte Pipe and Foundry Company.
 - c. Dallas Specialty & Mfg. Co.
 - d. Fernco Inc.
 - e. Ideal Tridon Group.
 - f. MIFAB, Inc.
 - g. Matco-Norca.
 - h. Mission Rubber Company, LLC; a division of MCP Industries.
 - i. Tyler Pipe; a subsidiary of McWane Inc.
 2. Standards: ASTM C1277 and CISPI 310.
 3. Description: Stainless steel corrugated shield with stainless steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.
- D. Heavy-Duty, Hubless-Piping Couplings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AB & I Foundry; a part of the McWane family of companies.
 - b. ANACO-Husky.
 - c. Charlotte Pipe and Foundry Company.
 - d. Dallas Specialty & Mfg. Co.
 - e. Ideal Tridon Group.
 - f. MIFAB, Inc.
 - g. Mission Rubber Company, LLC; a division of MCP Industries.
 - h. Tyler Pipe; a subsidiary of McWane Inc.
 2. Standards: ASTM C1277 and ASTM C1540..
 3. Description: Stainless steel shield with stainless steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.

2.5 PVC PIPE AND FITTINGS (ABOVE SLAB ONLY)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Apollo Valves; a part of Aalberts Integrated Piping Systems.

2. Charlotte Pipe and Foundry Company.
 3. GF Piping Systems.
 4. JM Eagle.
 5. National Pipe and Plastic, Inc.
 6. North America Pipe Corporation.
 7. Rocky Mountain Colby Pipe Company.
 8. Silver-line Plastics.
- B. Comply with NSF 14 for plastic piping components. Include "NSF-dwv" marking for plastic drain, waste, and vent piping and "NSF-sewer" marking for plastic sewer piping.
- C. Solid-Wall PVC Pipe: ASTM D2665 drain, waste, and vent.
- D. PVC Socket Fittings: ASTM D2665, made in accordance with ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- E. Adhesive Primer: ASTM F656.
- F. Solvent Cement: ASTM D2564.

2.6 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections of same size as and compatible with pipes to be joined.
 2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
 3. Unshielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Dallas Specialty & Mfg. Co.
 - 2) Fernco Inc.
 - 3) Mission Rubber Company, LLC; a division of MCP Industries.
 - 4) Plastic Oddities.
 - b. Standard: ASTM C1173.
 - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. End Connections: Same size as and compatible with pipes to be joined.
 - e. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C564, rubber.
 - 2) For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926 PVC.
 - 3) For Dissimilar Pipes: ASTM D5926 PVC or other material compatible with pipe materials being joined.
 4. Shielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Mission Rubber Company, LLC; a division of MCP Industries.
 - b. Standard: ASTM C1460.
 - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. End Connections: Same size as and compatible with pipes to be joined.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
 - 1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
 - 2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
 - 1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
 - 2. Use long-turn, double Y-branch, and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
 - a. Straight tees, elbows, and crosses may be used on vent lines.
 - 3. Do not change direction of flow more than 90 degrees.
 - 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
 - a. Reducing size of waste piping in direction of flow is prohibited.
- K. Lay buried building waste piping beginning at low point of each system.
 - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
 - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
 - 3. Maintain swab in piping and pull past each joint as completed.
- L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
 - 1. Building Sanitary Waste: Two percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Horizontal Sanitary Waste Piping: 1 percent downward in direction of flow.
 - 3. Vent Piping: One percent down toward vertical fixture vent or toward vent stack.
- M. Install cast-iron soil piping in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

- N. Install aboveground PVC piping in accordance with ASTM D2665.
- O. Plumbing Specialties:
 - 1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
 - a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
 - b. Comply with requirements for cleanouts specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
 - 2. Install drains in sanitary waste gravity-flow piping.
 - a. Comply with requirements for drains specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
- P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- Q. Install sleeves for piping penetrations of walls, ceilings, and floors.
 - 1. Comply with requirements for sleeves specified in Section 22 05 00 "Common Work Results for Plumbing."
- R. Install sleeve seals for piping penetrations of concrete walls and slabs.
 - 1. Comply with requirements for sleeve seals specified in Section 22 05 00 "Common Work Results for Plumbing."
- S. Install escutcheons for piping penetrations of walls, ceilings, and floors.
 - 1. Comply with requirements for escutcheons specified in Section 22 05 00 "Common Work Results for Plumbing."

3.2 JOINT CONSTRUCTION

- A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Hubless, Cast-Iron Soil Piping Coupled Joints:
 - 1. Join hubless, cast-iron soil piping in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- C. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:
 - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join in accordance with ASTM D2235 and ASTM D2661 appendixes.
 - 3. PVC Piping: Join in accordance with ASTM D2855 and ASTM D2665 appendixes.
- D. Joint Restraints and Sway Bracing:
 - 1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:
 - a. Provide axial restraint for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction, branches, and changes in diameter greater than two pipe sizes.
 - b. Provide rigid sway bracing for pipe and fittings 4 inches and larger, upstream and downstream of all changes in direction 45 degrees and greater.
 - c. Provide rigid sway bracing for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction and branch openings.

3.3 INSTALLATION OF SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in ODs.
 - 2. In Waste Drainage Piping: Unshielded, nonpressure transition couplings.
- B. Dielectric Fittings:
 - 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
 - 2. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric unions.
 - 3. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric nipples.
 - 4. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.4 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment".
 - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 - 2. Install stainless steel pipe hangers for horizontal piping in corrosive environments.
 - 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 - 4. Install stainless steel pipe support clamps for vertical piping in corrosive environments.
 - 5. Vertical Piping: MSS Type 8 or Type 42 clamps.
 - 6. Install individual, straight, horizontal piping runs:
 - a. 100 Ft. (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Ft. (30 m): MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Ft. (30 m) if Indicated: MSS Type 49, spring cushion rolls.
 - 7. Multiple, Straight, Horizontal Piping Runs 100 Ft. (30 m) or Longer: MSS Type 44 pipe rolls. Support pipe rolls on trapeze.
 - 8. Base of Vertical Piping: MSS Type 52 spring hangers.
- C. Install hangers for cast-iron soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Install hangers for PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Support horizontal piping and tubing within 12 inches of each fitting and coupling.
- F. Support vertical runs of cast-iron soil piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- G. Support vertical runs of PVC piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.5 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect waste and vent piping to the following:
 - 1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 - 5. Comply with requirements for cleanouts and drains specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
 - 6. Equipment: Connect waste piping as indicated.
 - a. Provide shutoff valve if indicated and union for each connection.
 - b. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections in accordance with the following unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.6 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping.
- B. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.7 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.

- a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
 - a. Close openings in piping system and fill with water to point of overflow, but not less than 10 ft. head of water.
 - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
 - c. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
 - a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1 inch wg.
 - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
 - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
 - d. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.8 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Repair damage to adjacent materials caused by waste and vent piping installation.

3.9 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 (DN 100) and smaller are to be the following:
 1. Service cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
 3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 4. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- C. Aboveground, vent piping NPS 4 (DN 100) is to be the following:
 1. Service cast iron, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
 3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 4. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.

- D. Underground, soil, waste, and vent piping NPS 4 (DN 100) and smaller are to be the following:
1. Service cast-iron soil piping; gaskets; and gasketed joints.

END OF SECTION

SECTION 22 13 19

SANITARY WASTE PIPING SPECIALTIES

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. Cleanouts.
 2. Air-admittance valves.
 3. Miscellaneous sanitary drainage piping specialties.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile butadiene styrene.
- B. PVC: Polyvinyl chloride.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 1. Show fabrication and installation details for frost-resistant vent terminals.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

- A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

2.2 CLEANOUTS

- A. Cast-Iron Exposed Cleanouts:
 1. Standard: ASME A112.36.2M.
 2. Size: Same as connected drainage piping
 3. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
 4. Closure: Countersunk, plug.

5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- B. Cast-Iron Exposed Floor Cleanouts:
1. Standard: ASME A112.36.2M for cast-iron soil pipe with cast-iron ferrule cleanout.
 2. Size: Same as connected branch.
 3. Type: Cast-iron soil pipe with cast-iron ferrule.
 4. Body or Ferrule: Cast iron.
 5. Clamping Device: .
 6. Outlet Connection: Inside calk.
 7. Closure: Brass plug with tapered threads.
 8. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
 9. Frame and Cover Shape: Round.
 10. Top-Loading Classification: Medium Duty.
 11. Riser: ASTM A74, Service Class, cast-iron drainage pipe fitting and riser to cleanout.
- C. Cast-Iron Wall Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. WATTS; A Watts Water Technologies Company.
 - e. Zurn Industries, LLC.
 2. Standard: ASME A112.36.2M. Include wall access.
 3. Size: Same as connected drainage piping.
 4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
 5. Closure Plug:
 - a. Brass.
 - b. Countersunk or raised head.
 - c. Drilled and threaded for cover attachment screw.
 - d. Size: Same as or not more than one size smaller than cleanout size.
 6. Wall Access, Cover Plate: Round, flat, chrome-plated brass or stainless steel cover plate with screw.

2.3 AIR-ADMITTANCE VALVES

- A. Fixture Air-Admittance Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ayrlett, LLC.
 - b. Oatey Co.
 - c. ProVent Systems.
 - d. Studor, Inc.
 2. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.
 3. Housing: Plastic.
 4. Operation: Mechanical sealing diaphragm.
 5. Size: Same as connected fixture or branch vent piping.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.
 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. Install fixture air-admittance valves on fixture drain piping.
- E. Install air-admittance-valve wall boxes recessed in wall.

3.2 PIPING CONNECTIONS

- A. Comply with requirements in Section 22 13 16 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment, to allow service and maintenance.

3.3 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.
1. Nameplates and signs are specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 22 34 00

FUEL-FIRED, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Commercial, grid-type, finned-tube, gas-fired, domestic-water heaters.
 - 2. Domestic-water heater accessories.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Equipment room drawing or BIM model, drawn to scale, on which the items described in this Section are shown and coordinated with all building trades.
- B. Product Certificates: For each type of commercial, gas-fired, domestic-water heater.
- C. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- D. Source quality-control reports.
- E. Field quality-control reports.
- F. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuel-fired, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.5 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Periods: From date of Substantial Completion.
 - a. Commercial, Finned-Tube, Gas-Fired, Domestic-Water Heaters:

- 1) Heat Exchanger: Five years.
 - 2) Controls and Other Components: Two year(s).
 - 3) Separate Hot-Water Storage Tanks: Five years.
- b. Expansion Tanks: Five years.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.
- B. ASHRAE/IES Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IES 90.1.
- C. ASME Compliance:
1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube, domestic-water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

2.2 COMMERCIAL, FINNED-TUBE, GAS-FIRED, DOMESTIC-WATER HEATERS

- A. Commercial, Grid-Type, Finned-Tube, Gas-Fired, Domestic-Water Heaters:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. A. O. Smith Corporation.
 - b. CAMUS Hydronics Ltd.
 - c. Laars Heating Systems Company; a subsidiary of Bradford White Corporation.
 - d. Lochinvar, LLC.
 2. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.
 3. Standard: ANSI Z21.13/CSA 4.9 for hot-water-supply boilers.
 4. Description: Packaged unit with boiler, storage tank, pump, piping, and controls.
 5. Boiler Construction: ASME code with 160-psig working-pressure rating for hot-water-boiler-type, domestic-water heater.
 - a. Heat Exchanger: Horizontal, straight, finned-copper tubes with bronze headers.
 - b. Connections: Factory fabricated of materials compatible with boiler. Attach to boiler before testing.
 - 1) NPS 2 (DN 50) and Smaller: Threaded ends in accordance with ASME B1.20.1.
 - 2) NPS 2-1/2 (DN 65) and Larger: Flanged ends in accordance with ASME B16.5 for steel and stainless steel flanges and in accordance with ASME B16.24 for copper and copper-alloy flanges.
 6. Boiler Appurtenances:
 - a. Insulation: Comply with ASHRAE/IES 90.1. Surround entire boiler except connections and controls.
 - b. Jacket: Steel with enameled finish.
 - c. Burner: For use with grid-type, finned-tube, gas-fired, domestic-water heaters and natural-gas fuel.

- d. Automatic Ignition: ANSI Z21.20/CSA C22.2 No. 60730-2-5, intermittent electronic-ignition system.
 - e. Temperature Control: Adjustable, storage-tank temperature-control fitting and flow switch, interlocked with circulator and burner.
 - f. Safety Control: Automatic, high-temperature-limit cutoff device or system.
7. Support: Steel base or skids.
8. Hot-Water Storage Tank: Connected with piping to circulating pump and domestic-water heater.
- a. Construction: In accordance with ASME Boiler and Pressure Vessel Code: Section VIII, steel with 150-psig working-pressure rating.
 - b. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
 - 1) NPS 2 (DN 50) and Smaller: Threaded ends in accordance with ASME B1.20.1.
 - 2) NPS 2-1/2 (DN 65) and Larger: Flanged ends in accordance with ASME B16.5 for steel and stainless steel flanges and in accordance with ASME B16.24 for copper and copper-alloy flanges.
 - c. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
9. Factory-Installed, Storage-Tank Appurtenances:
- a. Anode Rods: Factory installed, magnesium.
 - b. Drain Valve: Corrosion-resistant metal with hose-end connection.
 - c. Insulation: Comply with ASHRAE/IES 90.1. Surround entire storage tank except connections and controls.
 - d. Jacket: Steel with enameled finish.
 - e. Combination Temperature-and-Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select one relief valve with sensing element that extends into storage tank.
10. Circulating Pump: UL 778, all-bronze, centrifugal, overhung-impeller, separately coupled in-line pump as defined in HI 1.1-1.2 and HI 1.3. Include mechanical seals, 125-psig minimum working-pressure rating, and 225 deg F continuous-water-temperature rating.
11. Piping: Copper tubing; copper, solder-joint fittings; and brazed or flanged joints.
12. Mounting: Domestic-water heater, tank, and accessories factory mounted on skids.

2.3 DOMESTIC-WATER HEATER ACCESSORIES

- A. Domestic-Water Expansion Tanks:
- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. A. O. Smith Corporation.
 - b. AMTROL, Inc.
 - c. State Industries.
 - d. Taco Comfort Solutions.
 - 2. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.
 - 3. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
 - 4. Construction:
 - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.

- b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed.
- B. Comply with requirements for ball-, butterfly-, or gate-type shutoff valves specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping," Section 22 05 23.13 "Butterfly Valves for Plumbing Piping," and Section 22 05 23.15 "Gate Valves for Plumbing Piping."
 - 1. Comply with requirements for balancing valves specified in Section 22 11 19 "Domestic Water Piping Specialties."
- C. Gas Shutoff Valves: ANSI Z21.15/CSA 9.1, manually operated. Furnish for installation in piping.
- D. Gas Pressure Regulators: ANSI Z21.18/CSA 6.3, appliance type. Include 1/2-psig pressure rating as required to match gas supply.
- E. Combination Temperature-and-Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valves with sensing element that extends into storage tank.
 - 1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4.
- F. Pressure Relief Valves: Include pressure setting less than working-pressure rating of domestic-water heater.
 - 1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4.
- G. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

2.4 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect assembled domestic-water heaters specified to be ASME-code construction, in accordance with ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.
- C. Domestic-water heaters will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF DOMESTIC-WATER HEATER

- A. Commercial, Domestic-Water Heater Mounting: Install commercial domestic-water heaters on concrete base. Comply with requirements for concrete base specified in Section 03 30 00 "Cast-in-Place Concrete."
 - 1. Exception: Omit concrete bases for commercial domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
 - 2. Maintain manufacturer's recommended clearances.
 - 3. Arrange units so controls and devices that require servicing are accessible.
 - 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 7. Install anchor bolts to elevations required for proper attachment to supported equipment.
 8. Anchor domestic-water heaters to substrate.
- B. Install domestic-water heaters level and plumb, in accordance with layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
 1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping."
 - C. Install gas-fired, domestic-water heaters in accordance with NFPA 54.
 1. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.
 2. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators .
 3. Comply with requirements for gas shutoff valves, gas pressure regulators, and automatic gas valves specified in Section 22 11 23 "Facility Natural-Gas Piping."
 - D. Install combination temperature-and-pressure relief valves in water piping for domestic-water heaters without storage. Extend domestic-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
 - E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 22 11 19 "Domestic Water Piping Specialties."
 - F. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in Section 22 05 00 "Common Work Results for Plumbing."
 - G. Assemble and install inlet and outlet piping manifold kits for multiple domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each domestic-water heater outlet. Comply with requirements for valves specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping," and comply with requirements for thermometers specified in Section 22 05 00 "Common Work Results for Plumbing."
 - H. Fill domestic-water heaters with water.
 - I. Charge domestic-water expansion tanks with air to required system pressure.
 - J. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water shall contain less than 0.25 percent of lead by weight.

3.2 PIPING CONNECTIONS

- A. Comply with requirements for domestic-water piping specified in Section 22 11 16 "Domestic Water Piping."
- B. Comply with requirements for fuel-oil piping specified in Section 23 11 13 "Facility Fuel-Oil Piping."

- C. Comply with requirements for gas piping specified in Section 22 "Facility Natural-Gas Piping."
- D. Drawings indicate general arrangement of piping, fittings, and specialties.
- E. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Domestic-water heaters will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial, gas-fired, storage, domestic-water heaters. Training shall be a minimum of two hour(s).

END OF SECTION

SECTION 22 42 13.13

COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wall-mounted water closets.
 - 2. Flushometer valves.
 - 3. Toilet seats.
 - 4. Supports.

1.2 DEFINITIONS

- A. Standard-Efficiency Flush Volume: 1.6 gal. per flush.
- B. High-Efficiency Flush Volume: 1.28 gal. or less per flush.
- C. WaterSense Fixture: Water closet and/or flushometer valve/tank certified by the EPA to meet the WaterSense performance criteria.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Include diagrams for power and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Materials: Furnish extra materials to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than six of each type.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Standards:
 - 1. Comply with ASME A112.19.2/CSA B45.1 for water closets.
 - 2. Comply with ASME A112.19.5/CSA B45.15 for flush valves and spuds for water closets and tanks.
 - 3. Comply with ASSE 1037/ASME A112.1037/CSA B125.37 for flush valves.
 - 4. Comply with IAMPO/ANSI Z124.5 for water-closet (toilet) seats.
 - 5. Comply with ASME A112.6.1M for water-closet supports.

6. Comply with ICC A117.1 for ADA-compliant water closets.
7. Comply with ASTM A1045 for flexible PVC gaskets used in connection of vitreous china water closets to sanitary drainage systems.
8. Comply with ASME A112.4.3 for plastic fittings used in connection of vitreous china water closets to sanitary drainage systems.

2.2 WALL-MOUNTED WATER CLOSETS

- A. Water Closets - Wall Mounted, Top Spud: .
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Advanced Modern Technologies Corporation - AMTC.
 - b. American Standard.
 - c. Gerber Plumbing Fixtures LLC.
 - d. Kohler Co.
 - e. Sloan Valve Company.
 - f. TOTO USA, INC.
 - g. Zurn Industries, LLC.
 2. Source Limitations: Obtain water closets from single source from single manufacturer.
 3. Bowl:
 - a. Material: Vitreous china.
 - b. Type: Siphon jet.
 - c. Style: Flushometer valve.
 - d. Rim Contour: Elongated.
 - e. Spud Size and Location: NPS 1-1/2; top.
 - f. Color: White.
 4. Flushometer Valve: Type 1.
 5. Toilet Seat: Type 1.
 6. Support: Water-closet carrier.

2.3 FLUSHOMETER VALVES

- A. Flushometer Valves - Diaphragm, Solenoid Actuated: Type1 .
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Delany Products.
 - b. Sloan Valve Company.
 - c. Zurn Industries, LLC.
 2. Source Limitations: Obtain flushometer valve from single source from single manufacturer.
 3. Minimum Pressure Rating: 125 psig.
 4. Features: Include integral check stop and backflow-prevention device.
 5. Material: Brass body with corrosion-resistant components.
 6. Style: Exposed.
 7. Exposed Flushometer-Valve Finish: Chrome-plated.
 8. Panel Finish: Chrome-plated or stainless steel.
 9. Actuator: Side or top mounted; listed and labeled as defined in NFPA 70, by qualified testing agency, and marked for intended location and application.
 10. Trip Mechanism: Battery-powered electronic sensor; listed and labeled as defined in NFPA 70, by qualified testing agency, and marked for intended location and application.
 11. Minimum Inlet: NPS 1.
 12. Minimum Outlet: NPS 1-1/4.

2.4 TOILET SEATS

- A. Toilet Seats: Type 1.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard.
 - b. Bemis Manufacturing Company.
 - c. Church Seats; Bemis Manufacturing Company.
 - d. Kohler Co.
 - e. TOTO USA, INC.
 - f. Zurn Industries, LLC.
 - 2. Source Limitations: Obtain toilet seat from single source from single manufacturer.
 - 3. Material: Plastic.
 - 4. Type: Commercial (Heavy duty).
 - 5. Shape: Elongated rim, open front.
 - 6. Hinge: Self-sustaining, check.
 - 7. Hinge Material: Noncorroding metal.
 - 8. Seat Cover: Not required.
 - 9. Color: White.
 - 10. Surface Treatment: Antimicrobial.

2.5 SUPPORTS

- A. Water-Closet Carrier:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. MIFAB, Inc.
 - c. WATTS; A Watts Water Technologies Company.
 - d. Zurn Industries, LLC.
 - 2. Source Limitations: Obtain water-closet carrier from single source from single manufacturer.
 - 3. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water-supply piping and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.
- B. Examine walls and floors for suitable conditions where water closets will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Water-Closet Installation:
 - 1. Install level and plumb.
 - 2. Install accessible, wall-mounted water closets at mounting height in accordance with ICC A117.1.
- B. Support Installation:
 - 1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
 - 2. Use carrier supports with waste-fitting assembly and seal.

3. Install floor-mounted, back-outlet water closets attached to building floor substrate, onto waste-fitting seals; and attach to support.
 4. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.
 5. Measure support height installation from finished floor, not structural floor.
- C. Flushometer-Valve Installation:
1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
 2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
 3. Install actuators in locations easily reachable for people with disabilities.
 4. Install new batteries in battery-powered, electronic-sensor mechanisms.
- D. Install toilet seats on water closets.
- E. Wall Flange and Escutcheon Installation:
1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
 2. Install deep-pattern escutcheons if required to conceal protruding fittings.
 3. Comply with escutcheon requirements specified in Section 22 05 00 "Common Work Results for Plumbing."
- F. Joint Sealing:
1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
 2. Match sealant color to water-closet color.

3.3 PIPING CONNECTIONS

- A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.
- B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.

3.5 ADJUSTING

- A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.
- C. Install new batteries in battery-powered, electronic-sensor mechanisms.

3.6 CLEANING AND PROTECTION

- A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.

- B. Install protective covering for installed water closets and fittings.
- C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 22 42 16.13

COMMERCIAL LAVATORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Vitreous-china, wall-mounted lavatories.
 - 2. Manually operated lavatory faucets.
 - 3. Supply fittings.
 - 4. Waste fittings.
 - 5. Lavatory supports.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.
 - 1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
 - a. Servicing and adjustments of automatic faucets.

1.5 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. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
 - 2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

- A. Lavatory - Rectangular, Vitreous China, Wall Mounted, with Back:
 - 1. Fixture:
 - a. Standard: ASME A112.19.2/CSA B45.1.
 - b. Type: For wall hanging.
 - c. Faucet-Hole Location: Top.

- d. Color: White.
- e. Mounting Material: Chair carrier.
- 2. Faucet: Type 1.
- 3. Support: Type II, concealed-arm lavatory carrier..

2.2 MANUALLY OPERATED LAVATORY FAUCETS

- A. Lavatory faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61/NSF 372, or be certified in compliance with NSF 61/NSF 372 by an American National Standards Institute (ANSI) accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. Lavatory Faucets - Manual Type: Single-Control Mixing, Commercial, Type 1:
 - 1. Standard: ASME A112.18.1/CSA B125.1.
 - 2. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
 - 3. Body Type: Centerset.
 - 4. Body Material: Commercial, solid-brass, or die-cast housing with brazed copper and brass waterway.
 - 5. Finish: Polished chrome plate.
 - 6. Drain: Not part of faucet.

2.3 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless steel wall flange.
- D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type valve with inlet connection matching supply piping.
- E. Operation: Loose key.
- F. Risers:
 - 1. NPS 3/8.
 - 2. ASME A112.18.6/CSA B125.6, braided- or corrugated-stainless steel, flexible hose riser.

2.4 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.
- C. Trap:
 - 1. Size: NPS 1-1/4.
 - 2. Material:
 - a. Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated, brass or steel wall flange.

2.5 LAVATORY SUPPORTS

- A. Lavatory Carrier:
 - 1. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.
- B. Examine counters and walls for suitable conditions where lavatories will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install lavatories level and plumb in accordance with roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-mounted lavatories.
- C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, in accordance with ICC A117.1.
- D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 00 "Common Work Results for Plumbing."
- E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."
- F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."

3.3 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

- A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.
- B. Install new batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

- A. After completing installation of lavatories, inspect and repair damaged finishes.
- B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed lavatories and fittings.
- D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 22 42 16.16

COMMERCIAL SINKS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Service sinks.
 - 2. Manually operated sink faucets.
 - 3. Supply fittings.
 - 4. Waste fittings.
 - 5. Grout.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sinks.
 - 2. Include rated capacities, operating characteristics and furnished specialties and accessories.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted sinks.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sinks and faucets to include in operation and maintenance manuals.
 - 1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
 - a. Servicing and adjustments for automatic faucets.

1.5 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. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
 - 2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 SERVICE SINKS

- A. Service Sinks - Plastic, Floor Mounted: MSB .
 - 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. ProFlo; a Ferguson Enterprises, Inc. brand.
 - b. Zurn Industries, LLC.
 - 2. Source Limitations: Obtain sinks from single source from single manufacturer.
 - 3. Fixture:
 - a. Standard: CSA B45.5/IAPMO Z124.

- b. Material: Molded polymer.
- c. Rim Guard: On all top surfaces.
- d. Drain: Grid with NPS 3 outlet.
- 4. Mounting: On floor and flush to wall.
- 5. Faucet: Type 1.

2.2 MANUALLY OPERATED SINK FAUCETS

- A. Sink faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. Commercial Service Sink Faucets - Manual Type: Type1 .
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company; a Division of Morris Group International.
 - b. American Standard.
 - c. Central Brass Company; a Pioneer Industries, Inc. brand.
 - d. Chicago Faucets; Geberit Group.
 - e. Fiat Products.
 - f. T&S Brass and Bronze Works, Inc.
 - g. Zurn Industries, LLC.
 - 2. Source Limitations: Obtain sink faucets from single source from single manufacturer.
 - 3. Description: Wall/back mounted, brass body, with integral service stops, checks, spout with bucket/pail hook, 3/4-inch hose thread end, integral vacuum breaker, inlets 8 inches o.c., and two-handle mixing.
 - 4. Faucet:
 - a. Standards:
 - 1) ASME A112.18.1/CSA B125.1.
 - 2) NSF 61 and NSF 372.
 - 3) ICC A117.1.
 - 4) ASSE 1001 (VB).
 - b. Cartridges: One-fourth turn compression.
 - c. Brace: Adjustable top brace.
 - 5. Vacuum Breaker: Required for hose outlet.
 - 6. Spout Outlet: Hose thread in accordance with ASME B1.20.7.

2.3 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless steel wall flange.
- D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

2.4 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.

2.5 GROUT

- A. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000 psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water-supply piping and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.
- B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install sinks level and plumb in accordance with rough-in drawings.
- B. Set floor-mounted sinks in leveling bed of cement grout.
- C. Install water-supply piping with stop on each supply to each sink faucet.
 - 1. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping" and Section 22 05 23.15 "Gate Valves for Plumbing Piping."
 - 2. Install stops in locations where they can be easily reached for operation.
- D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 00 "Common Work Results for Plumbing."
- E. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."

3.3 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

- A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.

- B. Install new batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

- A. After completing installation of sinks, inspect and repair damaged finishes.
- B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed sinks and fittings.
- D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 22 47 16

PRESSURE WATER COOLERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pressure water coolers.
 - 2. Supports.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of pressure water cooler and bottle filling station.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. Include diagrams for power wiring.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For pressure water coolers to include in maintenance manuals.

1.4 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. Filter Cartridges: Equal to 10 percent of quantity installed for each type and size indicated, but no fewer than 2 of each.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Standards:
 - 1. Pressure water coolers and bottle filling stations intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 or NSF 372, or be certified in compliance with NSF 61 or NSF 372 by an ANSI-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
 - 2. Comply with ASHRAE 34 for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.
 - 3. Comply with UL 399.
 - 4. Comply with ASME A112.19.3/CSA B45.4.
 - 5. 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.
 - 6. Comply with NSF 42 and NSF 53 for water filters for water coolers and bottle filling stations.
 - 7. Comply with ICC A117.1 for accessible water coolers and bottle filling stations.

2.2 PRESSURE WATER COOLERS

- A. Pressure Water Coolers - Surface Wall-Mounted, Stainless Steel: EWC-A.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Elkay.
 - b. Halsey Taylor.
 - c. Murdock Manufacturing; A Division of Morris Group International.
 - 2. Source Limitations: Obtain surface wall-mounted, stainless steel, pressure water coolers from single source from single manufacturer.
 - 3. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
 - 4. Control: Push bar.
 - 5. Bottle Filler: Sensor activation, with 20-second automatic shutoff timer: Fill rate 0.5 to 1.5 gpm.
 - 6. Drain: Grid with NPS 1-1/4 tailpiece.
 - 7. Supply: NPS 3/8 with shutoff valve.
 - 8. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.
 - 9. Filter: One or more water filters with capacity sized for unit peak flow rate.
 - 10. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
 - 11. Support: Water-cooler carrier.
 - 12. Water-Cooler Mounting Height: High/low - standard/accessible in accordance with ICC A117.1.
 - 13. Capacities and Characteristics: Refer to Drawings.

2.3 SUPPORTS

- A. Water-Cooler Carrier:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Wade; a subsidiary of McWane Inc.
 - e. Zurn Industries, LLC.
 - 2. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls and floors for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- B. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

- C. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping"
- D. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- E. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 00 "Common Work Results for Plumbing."
- F. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."

3.3 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."
- C. Install ball shutoff valve on water supply to each fixture. Install valve upstream from filter for water cooler. Comply with valve requirements specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping"
- D. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

3.4 ELECTRICAL CONNECTIONS

- A. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- B. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
- C. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
 - 1. Nameplates to be laminated acrylic or melamine plastic signs, as specified in Section 26 05 53 "Identification for Electrical Systems."
 - 2. Nameplates to be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.5 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust pressure water-cooler temperature settings.

3.6 CLEANING

- A. After installing fixture, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.
- C. Provide protective covering for installed fixtures.
- D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 22 91 23

FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipes, tubes, and fittings.
 - 2. Joining materials.
 - 3. Manual gas shutoff valves.
 - 4. Pressure regulators.

1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. An example includes rooftop locations.
- C. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- D. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Piping specialties.
 - 2. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
 - 3. Pressure regulators. Indicate pressure ratings and capacities.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.
- B. Certificates:
 - 1. Welding certificates.
- C. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.
- D. Field Quality-Control Submittals:
 - 1. Field quality-control reports.
- E. Qualification Statements: For professional engineer.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pressure regulators to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Steel Support Welding: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. Pipe Welding: Qualify procedures and operators in accordance with the ASME Boiler and Pressure Vessel Code.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping in accordance with requirements of authorities having jurisdiction.
- B. 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.
- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.
- D. Protect stored PE pipes and valves from direct sunlight.

1.8 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. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide purging and startup of natural-gas supply in accordance with requirements indicated:
 - 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of natural-gas service.
 - 2. Do not proceed with interruption of natural-gas service without Construction Manager's written permission.

1.9 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate requirements for access panels and doors for valves installed and concealed behind finished surfaces. Comply with requirements in Section 08 31 13 "Access Doors and Frames."
- C. Coordinate requirements for piping identification for natural-gas piping. Comply with requirements in Section 22 05 53 "Identification of Plumbing Piping and Equipment."

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each product type from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Comply with **2020 Fuel Gas Code of NYS**.
- B. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.
- C. Natural-Gas System Pressure within Buildings:
1. Single Pressure: 0.5 psig or less.
 2. Two pressure ranges. Primary pressure is more than 0.5 psig, but not more than 2 psig, and is reduced to secondary pressure of 0.5 psig or less.
 3. Two pressure ranges. Primary pressure is more than 2 psig, but not more than 5 psig, and is reduced to secondary pressure of more than 0.5 psig, but not more than 2 psig.
 4. Three pressure ranges. Primary pressure is more than 2 psig, but not more than 5 psig, and is reduced to secondary pressures of more than 0.5 psig, but not more than 2 psig, and is reduced again to pressures of 0.5 psig or less.
- 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.

2.3 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A53/A53M, black steel, Schedule 40, Type E or S, Grade B.
1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 2. Wrought-Steel Welding Fittings: ASTM A234/A234M for butt welding and socket welding.
 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
 4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Threaded or butt welding to match pipe.
 - c. Lapped Face: Not permitted underground.
 - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum O-rings, and spiral-wound metal gaskets.
 - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
 5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
 - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

2.4 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.5 MANUAL GAS SHUTOFF VALVES

- A. See "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles for where each valve type is applied in various services.
- B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
 1. CWP Rating: 125 psig.

2. Threaded Ends: Comply with ASME B1.20.1.
 3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
 4. Tamperproof Feature: Locking feature for valves indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
 5. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
 6. Service Mark: Valves NPS 1-1/4 to NPS 2 having initials "WOG" permanently marked on valve body.
- C. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
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. A.Y. McDonald Mfg. Co.
 - b. Apollo Flow Controls; Conbraco Industries, Inc.
 - c. BrassCraft Manufacturing Co.; a Masco company.
 - d. Lyall, R. W. & Company, Inc.
 - e. Perfection Corporation.
 2. Body: Bronze, complying with ASTM B584.
 3. Ball: Chrome-plated bronze.
 4. Stem: Bronze; blowout proof.
 5. Seats: Reinforced TFE; blowout proof.
 6. Packing: Threaded-body packnut design with adjustable-stem packing.
 7. Ends: Threaded, flared, or socket as indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
 8. CWP Rating: 600 psig.
 9. Listing: Valves NPS 1 and smaller are to be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- D. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.
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. A.Y. McDonald Mfg. Co.
 - b. Mueller Co.
 - c. Xomox Corporation
 2. Body: Cast iron, complying with ASTM A126, Class B.
 3. Plug: Bronze or nickel-plated cast iron.
 4. Seat: Coated with thermoplastic.
 5. Stem Seal: Compatible with natural gas.
 6. Ends: Threaded or flanged as indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
 7. Operator: Square head or lug type with tamperproof feature where indicated.
 8. Pressure Class: 125 psig.
 9. Listing: Valves NPS 1 and smaller are to be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.6 PRESSURE REGULATORS

- A. General Requirements:
1. Single stage and suitable for natural gas.
 2. Steel jacket and corrosion-resistant components.
 3. Elevation compensator.

4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.
- B. Appliance Pressure Regulators: Comply with ANSI Z21.18.
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. Canadian Meter Company Inc.
 - b. Dormont; a WATTS brand.
 - c. Eaton.
 - d. Harper Wyman Co.
 - e. Maxitrol Company.
 - f. SCP, Inc.
 2. Body and Diaphragm Case: Die-cast aluminum.
 3. Springs: Zinc-plated steel; interchangeable.
 4. Diaphragm Plate: Zinc-plated steel.
 5. Seat Disc: NBR.
 6. Seal Plug: UV-stabilized, mineral-filled nylon.
 7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
 8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
 9. Maximum Inlet Pressure: 1 psig.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect natural-gas piping in accordance with 2020 Fuel Gas Code of New York State to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with 2020 Fuel Gas Code of New York State requirements for preventing accidental ignition.

3.3 INSTALLATION OF INDOOR PIPING

- A. Comply with 2020 Fuel Gas Code of New York State for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Do not install piping in concealed locations unless sleeved with the sleeve open at both ends.

- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Where installing piping above accessible ceilings, allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access. Do not locate valves within return air plenums.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Verify final equipment locations for roughing-in.
- K. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- L. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
 2. Install sediment trap on both sides of regulators for gas reduction to 2 psig with valve and capped.
- M. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- N. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- O. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- P. Connect branch piping from top or side of horizontal piping.
- Q. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- R. Do not use natural-gas piping as grounding electrode.
- S. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- T. Install pressure gauge upstream and downstream from each line regulator. Pressure gauges are specified in Section 22 05 19 "Meters and Gauges for Plumbing Piping."

3.4 INSTALLATION OF VALVES

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless steel tubing, aluminum, or copper connector.
- B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.5 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
 - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
 - 1. Construct joints in accordance with AWS D10.12/D10.12M, using qualified processes and welding operators.
 - 2. Bevel plain ends of steel pipe.
 - 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

3.6 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment" for hangers, supports, and anchor devices.
- B. Install hangers for steel piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Support horizontal piping within 12 inches of each fitting.
- D. Support vertical runs of steel piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.7 PIPING CONNECTIONS

- A. Install natural-gas piping electrically continuous, and bonded to gas-appliance equipment grounding conductor of the circuit powering the appliance in accordance with NFPA 70.
- B. Where installing piping adjacent to appliances, allow space for service and maintenance of appliances.
- C. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

3.8 PAINTING

- A. Paint exposed, metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
 - 1. Alkyd System: MPI EXT 5.1D.
 - a. Prime Coat: Alkyd anticorrosive metal primer
 - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.

- c. Topcoat: Exterior alkyd enamel flat.
- d. Color: Yellow.

3.9 LABELING AND IDENTIFICATION

- A. Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for piping and valve identification.

3.10 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Test, inspect, and purge natural gas in accordance with 2020 New York State Fuel Gas Code and authorities having jurisdiction.
 - 2. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- B. Prepare test and inspection reports.

3.11 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

- A. Aboveground, branch piping NPS 1 and smaller is to be the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
- B. Aboveground, distribution piping is to be the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.

3.12 ABOVEGROUND, MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Valves in branch piping for single appliance are to be one of the following:
 - 1. Two-piece, full-port, bronze ball valves with bronze trim.
 - 2. Bronze plug valve.

END OF SECTION

SECTION 23 00 10

GENERAL REQUIREMENTS FOR HVAC

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 the Work of this Division.
 - 1. The intent of this Section is to complement Division 01 Specifications and to provide supplementary, trade-specific information.
 - 2. Refer conflicting requirements to Architect for a decision before proceeding. If a resolution is not obtained, assume the costliest to apply.
- B. Thoroughly study all Drawings and Specifications before submitting bids.
- C. Drawings and Specifications are to be considered as supplementing each other. Work specified but not shown or shown but not specified shall be performed or furnished as though mentioned in both Specifications and Drawings.
- D. Details on Drawings are to be considered typical for similar applications unless specifically noted otherwise.

1.2 SUMMARY

- A. Bid shall include the cost of all labor, materials, tools, transportation, equipment, insurance, temporary protection, rentals, permits, taxes, and all necessary and miscellaneous items required to provide various systems shown and described complete and in good operating condition whether or not these miscellaneous items are specifically described in the Specifications or shown on the Drawings.
- B. Install all work in accordance with all applicable codes and prepare supplemental detail drawings and Shop Drawings reflecting purchased equipment requirements as necessary to obtain approval of authorities having jurisdiction over this Project.
- C. Guarantee workmanship, materials, and performance of this Division's systems in accordance with the requirements of the Contract Documents.
- D. The following are specifically included without limiting the generality implied by the Drawings or Specifications:
 - 1. HVAC systems including:
 - a. General-duty valves for HVAC piping.
 - b. Hangers and supports for HVAC piping and equipment.
 - c. Identification for HVAC piping and equipment.
 - d. Testing, adjusting, and balancing for HVAC.
 - e. Duct and HVAC piping insulation.
 - f. Direct digital control (DDC) system for HVAC.
 - g. Sequence of operations for HVAC controls.
 - h. hydronic piping and hydronic piping specialties.
 - i. Metal ducts.
 - j. Air duct accessories.
 - k. Flexible ducts.
 - l. Diffusers, registers, and grilles.
 - m. Gas vents.
 - n. Packaged energy recovery units.
 - o. Packaged, rooftop air-conditioning units.
 - p. Variable-refrigerant-flow HVAC systems.
 - q. Valance heating and cooling units.

2. Apply firestopping to penetrations of fire-rated construction, to restore original fire-resistance rating of assembly, and as indicated in this Division's Specifications. Comply with requirements in this Section.
3. Submittal of forms and Drawings to review and permit agencies.
4. Submittals.
5. Record Documents.
6. Permits and Inspections: Apply for and obtain all required permits and inspections for all work in this Contract; pay all related fees and charges.

1.3 ALLOWANCES

- A. Refer to Division 01 Specifications.

1.4 UNIT PRICES

- A. Refer to Division 01 Specifications.

1.5 ALTERNATES

- A. Refer to Division 01 Specifications.

1.6 PROJECT MANAGEMENT AND COORDINATION

- A. General Requirements:
 1. Drawings show general design arrangement; install work substantially as indicated. Verify exact location and elevations on job. **DO NOT SCALE DRAWINGS.**
 2. Due to small scale of Drawings, it is not possible to indicate all offsets, fittings, changes in elevation, interferences, etc. Adjust installation of piping, ductwork, conduit, equipment locations, etc., to accommodate work with obstacles and interferences encountered.
 3. Advise the Construction Manager in timely manner of questions on equipment locations, heights, etc.
 4. Any reasonable location adjustment of equipment and associated services requested by the Architect/ Construction Manager, prior to work being installed, shall be done with no cost added to the Contract.
- B. Coordination with Other Divisions:
 1. Provide to other Divisions any information related to their appropriate trade concerning the equipment or any work of this Contract in ample time to prevent delay in building progress.
 2. Interference:
 - a. Thoroughly coordinate work with other Divisions and:
 - 1) Determine exact route or location of each piece of equipment, associated services, etc., before fabrication and installation.
 - 2) Maintain maximum headroom.
 - 3) Obtain Engineer's review before installing any work below 7'-0" clear headroom in mechanical areas.
 - 4) Install work of this Division so that all equipment is serviceable and operable.
 - b. Should Architect's details, field conditions, changes in equipment, or Shop Drawing information necessitate an important rearrangement, advise Architect and act in accordance with his directions.
- C. Coordination with Drawings: Review all Drawings and if necessary, request copies of Shop Drawings to coordinate work. If potential conflict occurs between this Division's Drawings and another Drawing, advise Construction Manager and Architect in writing. Do not proceed with work without written directive from Contract-designated authority.

- D. Scheduling and Procedure of Work:
1. The work of this Division shall be completed in accordance with Project schedule; otherwise, the Construction Manager shall have the right to install, at this Division's expense, any temporary work of this Division necessary to meet the scheduled completion date.
 2. As work occurs within or attached to existing structures:
 - a. Perform all work only on approved schedule.
 - b. Do not interfere with normal operation of existing systems.
 - c. Do not shut off any services without written authorization of Construction Manager.
 - d. Do as much work as possible prior to the shutdown to minimize the downtime.
 - e. Make temporary connections as necessary to maintain schedule agreed upon, with no cost added to the Contract.
 3. No radios, tape players, compact disc players, etc., shall be permitted on-site.
 4. Proper work attire shall be worn at all times.
 5. All Contractor personnel working at the Project site must obtain and display a valid identification badge. All vehicles must display a valid parking permit. Refer to Division 01 Specifications for additional requirements, such as parking permits and identification badges.

1.7 SUBMITTALS

- A. Supply submittals indicated in each Section of this Division's Specifications and in accordance with requirements of Division 01 Specifications. Supply separate submittals for each Section of Specifications and for each building.
- B. Wiring Diagrams: Electrically operated equipment shall include factory-approved wiring diagram illustrating proper connections to be made between equipment and power and equipment and auxiliary controls (where applicable).
- C. Penetration Firestopping: Submit product data and installer certificates signed by installer certifying that products have been installed in compliance with requirements.
- D. Clearly label each submittal with item name/description; Specifications' section, paragraph and/or subparagraph; and any pertinent Drawing detail reference information.
- E. Submit field quality-control reports when indicated in Part 3 of Division's Specifications.

1.8 QUALITY REQUIREMENTS

- A. Contractor shall be licensed in accordance with New York State General Business Law, Article 6-D.
- B. Observation of the Work:
 1. Architect/Engineer may make periodic visits to the job site to observe the general progress and quality of the work. Architect/Engineer will not make continuous or detailed on-site inspections to check the quality and/or quantity of work and will not be responsible for this Division's failure to carry out construction work in accordance with the Contract Documents, Project schedule, or unsound construction procedures or practices.
- C. Conflict Requirements:
 1. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.

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

1.9 REFERENCES

A. Industry Standards:

1. The following standards shall govern and shall constitute minimum requirements as approved. If the requirements of this Division's Specifications exceed those of the standards mentioned, this Division's Specifications shall govern.
 - a. Local and state building codes.
 - b. Local utility companies.
 - c. National Electrical Manufacturer's Association ("NEMA").
 - d. American Institute of Electronic and Electrical Engineers ("IEEE")
 - e. National Electrical Safety Code ("NESC").
 - f. National Electric Code ("NEC").
 - g. ETL, Factory Mutual ("FM"), or Underwriters Laboratories, Inc. ("UL"), approved or listed, wherever applicable to materials.
 - h. American National Standards Institute ("ANSI").
 - i. National Fire Protection Association ("NFPA")
 - j. Official Compilation of Codes, Rules and Regulations of the State of New York ("NYCRR") for education, health, and sanitary rules and regulations, including:
 - a) NFPA 101, Life Safety Code, 2015 edition (Part 711.2).
- 2) Chapter XXXIII – State Fire Prevention and Building Code Council, including:
 - a) Subchapter A – Uniform Fire Prevention and Building Code (Uniform Code):
 - (1) Uniform Fire Prevention and Building Code (Part 1219).
 - (2) Residential Construction (Part 1220).
 - (3) Building Construction (Part 1221).
 - (4) Plumbing Systems (Part 1222).
 - (5) Mechanical Systems (Part 1223).
 - (6) Fuel Gas Equipment and Systems (Part 1224).
 - (7) Fire Prevention (Part 1225).
 - (8) Property Maintenance (Part 1226).
 - (9) Existing Buildings (Part 1227).
 - (10) The following documents by reference: 2020 Residential Code of New York State, 2020 Plumbing Code of New York State, 2020 Mechanical Code of New York State, 2020 Building Code of New York State, 2020 Fire Code of New York State, 2020 Existing Building Code of New York State, 2020 Fuel Gas Code of New York State, and 2020 Property Maintenance Code of New York State.
 - b) Subchapter B – State Energy Conservation Construction Code (Energy Code):
 - (1) State Energy Conservation Construction Code (Part 1240).
 - (2) The following documents by reference: 2020 Energy Conservation Construction Code, 2016 ASHRAE 90.1, and 2007 ASHRAE 183.
- k. Federal Register Americans Disabilities Act ("ADA"); and ICC/ANSI A117.1, the Handicapped Accessibility Code.
- l. New York State Education Department ("SED") "Manual of Planning Standards."
- m. Lewis County Administrative Rules and Regulations.
- n. Any other standards mentioned in this Division's Specifications.

- B. Materials and Equipment:
 - 1. Electrical devices, materials, and packaged equipment shall be listed and labeled by UL, FM, or ETL for the intended use and shall bear their label.
 - 2. Plastic materials or equipment with plastic components cannot be installed or used in or as part of a building unless:
 - a. Such covered product complies with the requirements of Chapter 26 of the Building Code of New York State.
 - b. A report of such compliance has been filed with the Department of State in accordance with the Building Code of New York State.
- C. Before submitting bid, consult above codes, regulations, and requirements and make all necessary provisions for same in bid.

1.10 TEMPORARY FACILITIES AND CONTROLS

- A. Refer to Division 01 Specifications.

1.11 PRODUCT REQUIREMENTS

- A. Refer to Division 01 Specifications.
- B. The term "product" shall mean items obtained for incorporating into the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes terms "materials," "equipment," "systems," and terms of similar intent.
- C. The Contract is based on products specified herein, shown on Drawings, and as authorized by addendum.
- D. Ensure all products conform to the Drawings and Specifications with regard to space requirements, performance, capacity, configuration, accessories, and materials of construction.
- E. Products furnished shall be new and, where used for similar purposes, of the same manufacturer. To the fullest extent possible, provide like products from a single source. If quantities from a single source cannot be provided, Architect/Engineer will make determination.
- F. Where the term "provide" is indicated, it shall have the same meaning as "furnish and install." All products listed shall be furnished and installed unless specifically noted to the contrary.
- G. Where the term "or equal" or "or approved equal" is indicated, it shall mean the same as "comparable product."
- H. Where "comparable product" is indicated, it shall mean a product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product. Contractor's request for comparable products will be considered when the following conditions are satisfied. If the following conditions are not satisfied, Engineer may return requests without action, except to record noncompliance with these requirements:
 - 1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 - 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - 3. Evidence that proposed product provides specified warranty.

4. If requested, list of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 5. If requested, samples.
- I. Where the term "basis-of-design product," including manufacturer and model number or other designation, is indicated, intent is to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the Specifications. Bear responsibility and cost for changes made necessary by the use of products other than those of the basis-of-design product.
- J. Where the term "substitution" is indicated, it shall mean changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
1. The products described in the Contract Documents establish a standard of required function, dimensions, appearance, and quality to be met by any proposed substitution.
 2. Contractor may make substitutions only with consent of Owner, after evaluation by the Architect/Engineer and in accordance with a Change Order.
 3. Substitution Procedures:
 - a. Follow substitution procedures indicated in Division 01 Specifications.
- K. Wherever subparagraph titles below introduce lists, the following requirements apply for product selection:
1. Available Manufacturers/Available Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers or products specified.
 - a. This is a non-restricted list. For unnamed manufacturer or unnamed product, product is considered a comparable product, not a substitution, and must be demonstrated and approved through submittal process.
 2. Manufacturers/Products: Subject to compliance with requirements, provide one of the specified products or products by one of specified manufacturers.
 - a. This is a restricted list. For unnamed manufacturer or unnamed product, product is considered a substitution.
 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product listed or a comparable product by one of the listed manufacturers.
 - a. Product by one of the listed manufacturers is considered a comparable product, not a substitution, and must be demonstrated and approved through submittal process.
 - b. For unnamed manufacturer or unnamed product, product is considered a substitution.
- L. Where "Manufacturer" or "Product" is indicated with only one named manufacturer or one named product, provide the product of the named manufacturer or the listed product. Comparable products or substitutions are not permitted.
- M. Justification for acceptance or rejection of unnamed products, unnamed manufacturers, comparable products, or product substitutions will not be demonstrated by the Architect/Engineer.
- N. Delivery, Storage, and Handling:
1. Deliver, store, and handle materials as recommended by the manufacturer.
 2. Handle and store materials in a manner which will not damage materials.
 3. Deliver and store materials throughout floor areas and in locations designated by Construction Manager. Provide blocking or pallets to prevent materials from becoming soiled.
 4. Schedule deliveries with Construction Manager prior to shipping.
 5. Be available at site to receive deliveries as scheduled.
 6. Hoist all materials as necessary to complete this Division's scope of work.

- O. Warranties:
 - 1. Refer to Sections of this Division's Specifications for specific warranties.
 - 2. Refer to Division 01 Specifications for submittal of warranties.

1.12 EXECUTION

- A. Examination of Premises and Existing Conditions:
 - 1. Examine all existing conditions affecting compliance with Drawings and Specifications by visiting site.
 - 2. Ascertain access to site, available storage, and delivery facilities.
 - 3. Verify all governing dimensions at site.
 - 4. Inspect all adjacent work.
 - 5. Verify the location, sizes, and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services; HVAC utility piping and other utilities.
 - 6. No consideration shall be given for alleged misunderstandings. Proceeding with the work indicates acceptance of existing conditions.

- B. Roughing:
 - 1. This Division's equipment shall be located generally as shown on Drawings; however, check actual field conditions to determine exact locations and avoid interference with other trades. Deviations from the Drawings proposed by this Division must be reviewed by the Construction Manager before the changes are made. Work improperly installed due to lack of construction verification shall be corrected at the expense of this Division.
 - 2. Before roughing for equipment furnished by others, obtain approved roughing drawings and exact location for each piece of equipment.
 - 3. Obtain Drawings or proper information giving final locations of all wiring, piping, ductwork, and motor and control connections.
 - 4. Unless otherwise detailed or specified:
 - a. All services shall be concealed in wall, above ceilings, etc.
 - b. Work shall be exposed only where approved by the Architect.
 - c. Notify Construction Manager and Architect if work cannot be concealed as intended.

- C. Cutting and Patching:
 - 1. Provide removals, cutting, patching, and replacement required for installation of the work in this Contract, except as noted on the Architectural (A series) Drawings.
 - a. Provide patching for all existing openings caused by the removal of existing ducts, fixtures, equipment, piping, conduit, cable tray, supports, etc.
 - 2. Before proceeding, meet at Project site with parties involved in cutting and patching, including General Contractor; notify Construction Manager; review areas of potential interference and conflict; coordinate procedures; and resolve potential conflicts.
 - 3. Patch shall match existing finishes.
 - 4. Refer to Division 01 Specifications for additional requirements.

- D. Connections to Equipment Furnished by Others:
 - 1. Various pieces of equipment will be furnished to the Project site and installed by other Divisions.
 - 2. Provide roughing-in and make final connections to equipment as indicated on the Drawings and/or as required.
 - 3. Before proceeding with the work, obtain full information regarding rough-in measurements, equipment layouts, elevations, trim being furnished, and other necessary data.
 - 4. Upon request, Construction Manager will provide this Division with diagrams, photographs, drawings, and/or specifications and other complete descriptive data

- showing all mechanical and electrical connections. Do not rough without approved layout from Construction Manager.
5. Provide accessories so that connections may be made in a manner that shall meet all referenced regulations and codes.
 6. See appropriate Sections of this Division's Specifications for materials and methods.
- E. Adjustment of Systems:
1. Set aside in the cost breakdown a sum to cover work in adjusting and balancing distribution systems.
 2. No payment will be made for balancing until Work of this Division is completed to the satisfaction of the Owner and Construction Manager.
- F. Protection of Openings and Equipment:
1. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
 2. Protect equipment which is factory-finished using Kraft paper, cardboard, canvas, reinforced polyethylene, etc. Clean and repaint damaged factory finish, matching the original equipment finish.
 3. Protect all equipment openings during construction with temporary plugs, caps, or reinforced plastic.
 4. Adequately protect existing flooring material, door frames, stairs, wall, etc., during construction. Use any combination of materials, such as plywood, polyethylene sheeting, framing lumber, etc., so that existing finishes are protected. Repair damage to existing finishes that were not completely protected.
- G. Progress Cleaning: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1.13 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

- A. Salvage of Existing Materials: Obtain from Construction Manager a list of existing items being removed, to be delivered to on-site storage as directed. Remove from site and legally dispose of items not specifically noted on said list.

1.14 CLOSEOUT PROCEDURES

- A. After all tests are made and installations pronounced satisfactory:
1. Thoroughly clean entire installation (both exposed surfaces and interiors) and leave in clean condition.
 2. Remove all debris caused by work.
 3. Promptly remove tools, surplus materials, and trailer when work is finally accepted.
- B. Repair damage to wall and to ceiling surface treatments caused by airborne dirt and debris from within ductwork systems.
- C. Lubrication:
1. Prior to final inspection and in the presence of Construction Manager:
 - a. Lubricate motors and motor-driven equipment in accordance with manufacturer's recommendations.
 - b. Check for operation without objectionable noise and for correct rotational direction. If noise or vibration is transmitted to occupied portions of the building by piping, equipment, etc., make changes and additions with no cost added to the Contract.

- c. Check motor protective devices for proper size.
 - 2. Provide neat, typewritten list of lubricant for each motor and moving parts.
 - a. Include list in operating and maintenance manual.
 - D. Valve Tagging Chart:
 - a. Include list in operating and maintenance manual.
 - E. Receipts for Loose Equipment:
 - 1. Prior to request for final payment:
 - a. Deliver to Construction Manager the following loose equipment:
 - 1) Diffuser and register adjustment keys.
 - 2) Valve charts.
 - 3) Control cabinet keys and any special tools needed to access/operate HVAC equipment.
 - 4) List of passwords/codes for access to and use of control system/energy management system (EMS).
 - 5) Spare filter sets.
 - b. Obtain signed receipt for delivered loose equipment.
 - 2. Include receipt in operations and maintenance manual.
- F. Refer to Division 01 Specifications for additional information on Project closeout and cleanup.

1.15 OPERATION AND MAINTENANCE DATA

- A. Submit 3 complete copies of operating and maintenance manuals for each building to the Construction Manager 60 days prior to scheduled date of substantial completion. Noncompliance or incomplete submittal will be rejected and returned for resubmittal.
 - 1. Photocopy paragraphs B and C below to be used a checklist for compliance with materials, format, and data.
 - 2. Once items are compiled, place a checkmark in the brackets for items included and strike through the items that do not apply.
 - 3. Submit checklist with operating and maintenance manuals.
- B. The operating and maintenance manuals shall consist of and will be reviewed for the following format and contents.
 - 1. Binder:
 - a. Three-ring, plain black, vinyl binder free of vendor/contractor logos, etc.
 - b. Cover and spine (binder) identification including:
 - 1) Manual title: "OPERATION AND MAINTENANCE MANUAL."
 - 2) Owner.
 - 3) Project title.
 - 4) Owner's project number.
 - 5) Year of construction.
 - 6) Trade(s).
 - 7) Volume number and total number of volumes (e.g., Volume 1 of 2).
 - 2. Contents:
 - a. Project title page (enclosed in clear, transparent plastic sleeve) to match cover identification with at least one-third page blank for review stamp and comments.
 - b. Project directory page (enclosed in a clear transparent plastic sleeve) including name, address, and telephone number of:
 - 1) Owner.
 - 2) Architect.
 - 3) Engineer.
 - 4) Contractor.
 - 5) Subcontractor.

- c. Table of contents (enclosed in a clear, transparent plastic sleeve) arranged to follow Specifications order (with format as list below):
- 1) Warranty letter.
 - 2) Summary of scheduled maintenance.
 - 3) Lubrication summary.
 - 4) Valve charts.
 - 5) Replacement filter media and size summary.
 - 6) List of maintenance parts, repair/replacement parts, and recommended spare parts, including equipment name, part number, and suppliers (name, address, and phone number).
 - 7) Letters of certification for required system tests.
 - 8) Include on table of contents the following information for each product:

Spec. Section Number	Equipment Description	Supplying Company	Local Representative	Telephone Number
230500	Widgets	Acme Company	John Doe	555-1212

- d. Submittals as indicated in "Submittals" Article of this Section, including:
- 1) Approved copies of all submittals, including parts lists.
 - 2) Material safety data sheets for:
 - a) Firestopping.
 - b) Insulations, facings, and adhesives.
 - c) Duct sealants.
 - 3) Installation, operating, and maintenance instructions.
 - 4) Wiring diagrams.
 - 5) Warranties.
 - 6) Test reports.

- C. Product Identification:
1. Provide indexed cardstock dividers between each submittal group.
 2. Arrange in an order corresponding to the original Project's Specifications.
 3. Where cataloged data covers more than one item, highlight applicable sections and identify corresponding equipment as marked on Drawings.
 4. Instructions shall include:
 - a. Time schedule for maintenance work (list each item of mechanical equipment requiring inspection, lubrication, or service) and description of the performance of such maintenance.
 - b. List of types of bearings for each piece of equipment with the type of lubricant required and frequency of lubrication.
 - c. Sequence of operating and/or flow diagrams for each of the systems, including emergency procedures.
 - d. Normal starting, operating, and shutdown procedures.

1.16 PROJECT RECORD DOCUMENTS

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Maintenance of Record Documents and Samples: Store record documents and samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Construction Manager's, Architect's, and/or Engineer's reference during normal working hours.
- C. Record Drawings:
1. Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

- a. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - 1) Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - 2) Accurately record information in an acceptable drawing technique.
 - 3) Record data as soon as possible after obtaining it.
 - 4) Record and check the markup before enclosing concealed installations.
 - 5) Cross-reference record prints to corresponding archive photographic documentation.
 - b. Content: Types of items requiring marking include, but are not limited to, the following:
 - 1) Dimensional changes to Drawings.
 - 2) Revisions to details shown on Drawings.
 - 3) Locations and depths of underground utilities.
 - 4) Revisions to routing of piping and conduits.
 - 5) Revisions to electrical circuitry.
 - 6) Actual equipment locations.
 - 7) Locations of concealed internal utilities.
 - 8) Duct size and routing.
 - 9) Locations of isolation valves, balance valves, drain valves, air vents.
 - 10) Locations of sensors for temperatures, pressures, smoke, carbon monoxide, and carbon dioxide.
 - 11) Locations of fire, smoke, and volume dampers.
 - 12) Changes made by Change Order or Construction Change Directive.
 - 13) Changes made following Architect's written orders.
 - 14) Details not on the original Contract Drawings.
 - 15) Field records for variable and concealed conditions.
 - 16) Record information on the Work that is shown only schematically.
 - c. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 - d. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 - e. Mark important additional information that was either shown schematically or omitted from original Drawings.
 - f. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
2. Submittals: Comply with the following:
- a. Submit Record Drawings as follows:
 - 1) Initial Submittal:
 - a) Submit paper-copy of marked-up record prints to Engineer for review. Submit a copy of each drawing, whether or not changes and additional information were recorded.
 - b) Engineer will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - 2) Final Submittal:
 - a) At the end of Project and after incorporating Engineer's review comments, submit paper-copy of final marked-up

record prints and PDF electronic files of scanned record prints on a digital video disk recordable (DVD-R) to Construction Manager. Print each drawing, whether or not changes and additional information were recorded.

- b. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
 - 1) Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include the following identification on cover sheets.
 - 2) PDFs: Organize into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification (i.e., Drawing Number). Include the following identification on DVD-R.
 - 3) Identification: As follows:
 - a) Project name.
 - b) Date.
 - c) Designation "PROJECT RECORD DRAWINGS."
 - d) Name of Architect.
 - e) Name of Contractor.
- D. Record Specifications: Comply with the following:
 - 1. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
 - a. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - b. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 - c. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 - d. Note related Change Orders, record Product Data, and record Drawings where applicable.
 - 2. Submittal: Submit paper copy of Record Specifications, including addenda and contract modifications, and scanned PDF electronic file(s) of marked-up paper copy of Specifications on DVD-R to Construction Manager. Identification shall be as stated hereinbefore for Record Drawings.
- E. Refer to Division 01 Specifications.

1.17 DEMONSTRATION AND TRAINING

- A. Owner's designated operating personnel shall be instructed in the care and operation of the systems in accordance with manufacturer's instructions and as indicated in these Specifications.
- B. Coordinate instruction schedule with Owner's operations. Notify Owner's personnel in advance of training. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.
- D. Training shall include, but not be limited to, the following systems:
 - 1. All HVAC equipment and systems including temperature controls.

1.18 WORK RELATED TO ASBESTOS AND WORK IN ASBESTOS-CONTAMINATED AREAS

- A. Portions of the existing mechanical systems and general construction are believed to be insulated or constructed with asbestos-containing materials.
- B. Asbestos-containing materials have reportedly contaminated portions of the crawlspace and ceiling plenum.
- C. Do not disturb such materials.
- D. Where work is unavoidable in contaminated areas, employ or subcontract the services of an "Allied Trade Certified Mechanic" (ATCM) to perform the work of this Division.
- E. It is understood that a separate contract has been, or will be, issued for the abatement of portions of the asbestos-containing materials.

PART 2 - PRODUCTS

2.1 PENETRATION FIRESTOPPING

- A. Available Manufacturers:
 - 1. A/D Fire Protection Systems Inc.
 - 2. Grace Construction Products.
 - 3. Hilti, Inc.
 - 4. Johns Manville.
 - 5. Nelson Firestop Products.
 - 6. NUCO Inc.
 - 7. Passive Fire Protection Partners.
 - 8. RectorSeal Corporation.
 - 9. Specified Technologies Inc.
 - 10. 3M Fire Protection Products.
 - 11. Tremco, Inc.; Tremco Fire Protection Systems Group.
 - 12. USG Corporation.
- B. Provide penetration firestopping materials that are compatible with one another, substrates, and penetrating items if any.
- C. Penetrations in Fire-Resistance-Rated Walls and Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
 - 1. F-Rating at Fire-Resistance-Rated Walls: Not less than that of construction penetrated.
 - 2. F-Rating at Horizontal Assemblies: At least 1 hour, but not less than that of construction penetrated.
- D. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.

PART 3 - EXECUTION

3.1 PENETRATION FIRESTOPPING

- A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

END OF SECTION

SECTION 23 05 23.12

BALL VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Bronze ball valves.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of valve.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. ASME Compliance:
 - 1. ASME B1.20.1 for threads for threaded-end valves.
 - 2. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 3. ASME B16.18 for cast copper solder-joint connections.
 - 4. ASME B16.22 for wrought copper and copper alloy solder-joint connections.
 - 5. ASME B16.34 for flanged and threaded end connections.
 - 6. ASME B31.9 for building services piping valves.
- B. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- C. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- D. Valve Sizes: Same as upstream piping unless otherwise indicated.
- E. Valve Actuator Types:
 - 1. Hand Lever: For quarter-turn valves smaller than NPS 4.
- F. Valves in Insulated Piping:
 - 1. Provide 2-inch extended neck stems.
 - 2. Extended operating handles with nonthermal-conductive covering material, and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
 - 3. Memory stops that are fully adjustable after insulation is applied.

2.2 BRONZE BALL VALVES

- A. Bronze Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim, Threaded or Soldered Ends:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. Crane; a Crane Co. brand.
 - c. Hammond Valve.
 - d. Jenkins Valves; a Crane Co. brand.
 - e. Milwaukee Valve Company.

- f. NIBCO INC.
- g. Red-White Valve Corp.
- h. Stockham; a Crane Co. brand.
- i. Viega LLC.
- j. WATTS.
- 2. Standard: MSS SP-110.
- 3. SWP Rating: 150 psig.
- 4. CWP Rating: 600 psig.
- 5. Body Design: Two piece.
- 6. Body Material: Bronze.
- 7. Ends: Threaded or soldered.
- 8. Seats: PTFE.
- 9. Stem: Stainless steel.
- 10. Ball: Stainless steel, vented.
- 11. Port: Full.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves. Remove defective valves from site.

3.2 INSTALLATION OF VALVES

- A. Install valves with unions or flanges at each piece of equipment arranged to allow space for service, maintenance, and equipment removal without system shutdown.
- B. Provide support of piping adjacent to valves such that no force is imposed upon valves.
- C. Locate valves for easy access.
- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full valve actuation movement.
- F. Adhere to manufacturer's written installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's recommended maximum.
- G. Adjust valve packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves exhibiting leakage.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified SWP classes or CWP ratings are unavailable, provide the same types of valves with higher SWP classes or CWP ratings.
- B. Select valves with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
 - 2. For Steel Piping, NPS 2 and Smaller: Threaded ends.

3.4 WATER/GLYCOL VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller: Bronze ball valves, two-piece, with stainless-steel trim, full port, and threaded, solder, or press-connection-joint ends.
 - 1. Valves may be provided with solder-joint ends instead of threaded ends.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Fastener systems.
 - 4. Equipment supports.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Equipment supports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

2.2 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pregalvanized, hot-dipped galvanized, or electro-galvanized.
 - 3. Nonmetallic Coatings: Plastic-coated, or epoxy powder-coated.
 - 4. Hanger Rods: Continuous-thread rod, nuts, and washer made of corrosion-resistant carbon steel.
- B. Copper Pipe and Tube Hangers:
 - 1. Description: MSS SP-58, Types 1 through 58, copper-plated steel, factory-fabricated components.
 - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-plated steel.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - c. MKT Fastening, LLC.
 - d. Simpson Strong-Tie Co., Inc.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. B-line, an Eaton business.
 - b. Hilti, Inc.
 - c. ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - d. MKT Fastening, LLC.

2.5 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with requirements in Section 23 00 10 "General Requirements for HVAC" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A36/A36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled strut systems.

- D. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- G. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- H. Install lateral bracing with pipe hangers and supports to prevent swaying.
- I. Install building attachments attached to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping.
- J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- L. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- G. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of non-insulated, stationary pipes NPS 3/4 to NPS 8.

7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
 8. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of non-insulated, stationary pipes NPS 3/8 to NPS 8.
 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of non-insulated, stationary pipes NPS 3/8 to NPS 3.
 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
- H. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- I. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- J. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
 2. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 3. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 4. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 5. C-Clamps (MSS Type 23): For structural shapes.
 6. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 7. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 8. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 9. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 10. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 11. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 12. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

- 13. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- K. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- L. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipe labels.
 - 2. Duct labels.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

PART 2 - PRODUCTS

2.1 PIPE LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Brady Corporation.
 - 2. Craftmark Pipe Markers.
 - 3. Marking Services Inc.
 - 4. Seton Identification Products; a Brady Corporation company.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- E. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- F. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:
 - 1. Pipe size.
 - 2. Flow-Direction Arrows: Include flow-direction arrows on distribution piping. Arrows may be either integral with label or applied separately.
 - 3. Lettering Size: Size letters in accordance with ASME A13.1 for piping.

2.2 DUCT LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Brady Corporation.
 - 2. Craftmark Pipe Markers.
 - 3. Marking Services Inc.
 - 4. Seton Identification Products; a Brady Corporation company.

- B. General Requirements for Manufactured Duct Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- H. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings. Also include the following:
 - 1. Duct size.
 - 2. Flow-Direction Arrows: Include flow-direction arrows on distribution ducts. Arrows may be either integral with label or may be applied separately.
 - 3. Lettering Size: Size letters in accordance with ASME A13.1 for piping.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION, GENERAL REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF PIPE LABELS

- A. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- B. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Within 3 ft. of each valve and control device.
 - 2. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 3. Within 3 ft. of equipment items and other points of origination and termination.
 - 4. Spaced at maximum intervals of 50 ft. along each run. Reduce intervals to 25 ft. in areas of congested piping, ductwork, and equipment.

- C. Flow-Direction Arrows: Use arrows to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- D. Pipe-Label Color Schedule:
 - 1. Heating Piping: Black letters on an ANSI Z535.1 safety-orange background.
 - 2. Refrigerant Piping: Black letters on an ANSI Z535.1 safety-orange background.

3.4 INSTALLATION OF DUCT LABELS

- A. Install self-adhesive duct labels showing service and flow direction with permanent adhesive on air ducts.
 - 1. Provide labels in the following color codes:
 - a. For air supply ducts: White letters on blue background.
 - b. For air return ducts: White letters on blue background.
 - c. For exhaust-, outside-, relief-, return-, and mixed-air ducts: White letters on blue background.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Testing, Adjusting, and Balancing of Air Systems:
 - a. Constant-volume air systems.
 - 2. Testing, Adjusting, and Balancing of Hydronic Piping Systems:
 - a. Constant-flow hydronic systems.
 - 3. Testing, adjusting, and balancing of equipment.
 - 4. Testing, adjusting, and balancing of existing HVAC systems and equipment.

1.2 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- F. TDH: Total dynamic head.
- G. AHJ: Authority having jurisdiction.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Certified TAB reports.
- C. Sample report forms.
- D. Instrument calibration reports, to include the following:
 - 1. Instrument type and make.
 - 2. Serial number.
 - 3. Application.
 - 4. Dates of use.
 - 5. Dates of calibration.

1.4 QUALITY ASSURANCE

- A. TAB Specialists Qualifications, Certified by AABC , NEBB or TABB:
 - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.
- B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

- C. Code and AHJ Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

1.5 FIELD CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- E. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- F. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.
- G. Examine control dampers for proper installation for their intended function of isolating, throttling, diverting, or mixing air flows.
- H. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes the following:
 - 1. Equipment and systems to be tested.
 - 2. Strategies and step-by-step procedures for balancing the systems.
 - 3. Instrumentation to be used.
 - 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
 - 1. Airside:
 - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
 - b. Duct systems are complete with terminals installed.
 - c. Volume, smoke, and fire dampers are open and functional.
 - d. Clean filters are installed.

- e. Fans are operating, free of vibration, and rotating in correct direction.
 - f. Variable-frequency controllers' startup is complete and safeties are verified.
 - g. Automatic temperature-control systems are operational.
 - h. Ceilings are installed.
 - i. Windows and doors are installed.
 - j. Suitable access to balancing devices and equipment is provided.
2. Hydronics:
- a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
 - b. Piping is complete with terminals installed.
 - c. Water treatment is complete.
 - d. Systems are flushed, filled, and air purged.
 - e. Control valves are functioning in accordance with the sequence of operation.
 - f. Shutoff and balance valves have been verified to be 100 percent open.
 - g. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system in accordance with the procedures contained in any of the following and in this Section:
 - 1. AABC's "National Standards for Total System Balance."
 - 2. ASHRAE 111.
 - 3. NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
- B. Cut insulation, ducts, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - 2. Where holes for probes are required in piping or hydronic equipment, install pressure and temperature test plugs to seal systems.
 - 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 23 07 13 "Duct Insulation," Section 23 07 16 "HVAC Equipment Insulation," and Section 23 07 19 "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

3.4 TESTING, ADJUSTING, AND BALANCING OF HVAC EQUIPMENT

- A. Test, adjust, and balance HVAC equipment indicated on Drawings, including, but not limited to, the following:
 - 1. Radiant heaters.
 - 2. Condensing units.
 - 3. Energy-recovery units.
 - 4. Rooftop air-conditioning units.
 - 5. Valance heating units.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' Record drawings duct layouts.

- C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- D. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- E. Verify that motor starters are equipped with properly sized thermal protection.
- F. Check dampers for proper position to achieve desired airflow path.
- G. Check for airflow blockages.
- H. Check condensate drains for proper connections and functioning.
- I. Check for proper sealing of air-handling-unit components.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
 - b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
 - c. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
 - 2. Measure fan static pressures as follows:
 - a. Measure static pressure directly at the fan outlet or through the flexible connection.
 - b. Measure static pressure directly at the fan inlet or through the flexible connection.
 - c. Measure static pressure across each component that makes up the air-handling system.
 - d. Report artificial loading of filters at the time static pressures are measured.
 - 3. Review Contractor-prepared shop drawings and Record drawings to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 - 4. Obtain approval from Construction Manager and Commissioning Authority for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 - 5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
 - 1. Measure airflow of submain and branch ducts.
 - 2. Adjust submain and branch duct volume dampers for specified airflow.
 - 3. Re-measure each submain and branch duct after all have been adjusted.
- C. Adjust air inlets and outlets for each space to indicated airflows.
 - 1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
 - 2. Measure inlets and outlets airflow.

3. Adjust each inlet and outlet for specified airflow.
 4. Re-measure each inlet and outlet after they have been adjusted.
- D. Verify final system conditions.
1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
 2. Re-measure and confirm that total airflow is within design.
 3. Re-measure all final fan operating data, speed, volts, amps, and static profile.
 4. Mark all final settings.
 5. Test system in economizer mode. Verify proper operation and adjust if necessary.
 6. Measure and record all operating data.
 7. Record final fan-performance data.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports for pumps, coils, and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and equipment flow rates with pump design flow rate.
- B. Prepare schematic diagrams of systems' Record drawings piping layouts.
- C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:
1. Check existing expansion tank(s) for proper setting.
 2. Check highest vent for adequate pressure.
 3. Locate existing start-stop and disconnect switches, electrical interlocks, and motor controllers.
 4. Check that air has been purged from the system.
- D. Measure and record upstream and downstream pressure of each piece of equipment.
- E. Measure and record upstream and downstream pressure of pressure-reducing valves.
- F. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.
1. Check settings and operation of each safety valve. Record settings.

3.8 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Adjust flow-measuring devices installed at terminals for each space to design water flows.
1. Measure flow at terminals.
 2. Adjust each terminal to design flow.
 3. Re-measure each terminal after it is adjusted.
 4. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
 5. Perform temperature tests after flows have been balanced.
- B. For systems with pressure-independent valves at terminals:
1. Measure differential pressure and verify that it is within manufacturer's specified range.
 2. Perform temperature tests after flows have been verified.
- C. Verify final system conditions as follows:
1. Re-measure and confirm that total water flow is within design.
 2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
 3. Mark final settings.

3.9 PROCEDURES FOR AIR-COOLED CONDENSING UNITS

- A. Verify proper rotation of fan(s).
- B. Measure and record entering- and leaving-air temperatures.
- C. Measure and record entering and leaving refrigerant pressures.
- D. Measure and record operating data of compressor(s), fan(s), and motors.

3.10 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
 - 1. Measure and record the operating speed, airflow, and static pressure of each fan and equipment with fan(s).
 - 2. Measure and record flows, temperatures, and pressures of each piece of equipment in each hydronic system. Compare the values to design or nameplate information, where information is available.
 - 3. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 - 4. Check the refrigerant charge.
 - 5. Check the condition of filters.
 - 6. Check the condition of coils.
 - 7. Check the operation of the drain pan and condensate-drain trap.
 - 8. Check bearings and other lubricated parts for proper lubrication.
 - 9. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. TAB After Construction: Before performing testing and balancing of renovated existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished in accordance with renovation scope indicated by Contract Documents. Verify the following:
 - 1. New filters are installed.
 - 2. Coils are clean and fins combed.
 - 3. Drain pans are clean.
 - 4. Fans are clean.
 - 5. Bearings and other parts are properly lubricated.
 - 6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
 - 1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
 - 2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
 - 3. If calculations increase or decrease the airflow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
 - 4. Balance each air outlet.

3.11 TOLERANCES

- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 10 percent or minus 5 percent. If design value is less than 100 cfm, within 10 cfm.

2. Air Outlets and Inlets: Plus 10 percent or minus 5 percent. If design value is less than 100 cfm, within 10 cfm.
 3. Heating Flow Rate: Plus 10 percent or minus 5 percent. If design value is less than 10 gpm, within 10 percent.
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.12 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 2. Include a list of instruments used for procedures, along with proof of calibration.
 3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Fan curves.
 2. Manufacturers' test data.
 3. Field test reports prepared by system and equipment installers.
 4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
 2. Name and address of the TAB specialist.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB supervisor who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents, including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 15. Test conditions for fans performance forms, including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Heating coil, dry-bulb conditions.
 - d. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Water flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.

- 7. Position of balancing devices.
- E. Instrument Calibration Reports:
 - 1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.13 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Construction Manager.
- B. Architect shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to the lesser of either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the TAB shall be considered incomplete and shall be rejected.
- E. If recheck measurements find the number of failed measurements noncompliant with requirements indicated, proceed as follows:
 - 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection. All changes shall be tracked to show changes made to previous report.
 - 2. If the second final inspection also fails, Owner may pursue others Contract options to complete TAB work.
- F. Prepare test and inspection reports.

END OF SECTION

SECTION 23 07 13

DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following duct services:
 - 1. Indoor, concealed supply and outdoor air.
 - 2. Indoor, exposed supply and outdoor air.
 - 3. Indoor, concealed exhaust between isolation damper and penetration of building exterior, and for 10 feet inboard from isolation damper.
 - 4. Indoor, exposed exhaust between isolation damper and penetration of building exterior, and for 10 feet inboard from isolation damper.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or craft training program, certified by the Department of Labor, Bureau of Apprenticeship and Training.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers are to be marked with the manufacturer's name, appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.5 COORDINATION

- A. Coordinate sizes and locations of supports and hangers.
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and finishes and for space required for maintenance.

1.6 SCHEDULING

- A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule" shown on Drawings.
- B. Products do not contain asbestos, lead, mercury, or mercury compounds.
- C. Glass-Fiber Blanket: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 450 deg F in accordance with ASTM C411. Comply with ASTM C553, Type II, and ASTM C1290, Type III with factory-applied FSK jacket and integral vapor barrier. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation; Saint-Gobain North America.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Manson Insulation Inc.
 - e. Owens Corning.
- D. Glass-Fiber Board Insulation: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 250 deg F for jacketed and between 35 deg F and 450 deg F for unfaced in accordance with ASTM C411. Comply with ASTM C612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ and integral vapor barrier. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation; Saint-Gobain North America.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Manson Insulation Inc.
 - e. Owens Corning.
- E. High-Temperature, Glass-Fiber Board: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 1000 deg F in accordance with ASTM C411. Comply with ASTM C612, Type III, unfaced.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation; Saint-Gobain North America.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Manson Insulation Inc.
 - e. Owens Corning.

2.3 ADHESIVES

- A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Glass-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.

- C. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.

2.4 MASTICS AND COATINGS

- A. Materials are compatible with insulation materials, jackets, and substrates.
- B. Vapor-Retarder Mastic: Water based; suitable for indoor use on below ambient services.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller Construction Products.
 - c. Knauf Insulation.
 - d. Vimasco Corporation.
 - 2. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Comply with MIL-PRF-19565C, Type II, for permeance requirements, with supplier listing on DOD QPD - Qualified Products Database.
 - 5. Color: White.

2.5 SEALANTS

- A. ASJ Flashing Sealants:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller Construction Products.
 - 2. Materials are compatible with insulation materials, jackets, and substrates.
 - 3. Fire- and water-resistant, flexible, elastomeric sealant.
 - 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 5. Color: White.

2.6 FACTORY-APPLIED JACKETS

- A. Insulation systems indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
 - 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
 - 3. ASJ+: All-service jacket composed of aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film leaving no paper exposed; complying with ASTM C1136, Types I, II, III, IV, and VII.

2.7 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Industrial Adhesives and Tapes Division.
 - b. Avery Dennison Corporation, Specialty Tapes Division.

- c. Ideal Tape Co., Inc., an American Biltrite Company.
- d. Knauf Insulation.
- 2. Width: 3 inches.
- 3. Thickness: 11.5 mils.
- 4. Adhesion: 90 ounces force/inch in width.
- 5. Elongation: 2 percent.
- 6. Tensile Strength: 40 lbf/inch in width.
- 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

2.8 SECUREMENTS

- A. Insulation Pins and Hangers:
 - 1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - 2. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Provide adhesively attached pins ONLY when weld pins are not possible to install due to space constraints. Comply with the following requirements:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) AGM Industries, Inc.
 - 2) Gemco.
 - 3) Midwest Fasteners, Inc.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low-carbon steel; aluminum; or stainless steel; fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 - 3. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel, aluminum, or stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) AGM Industries, Inc.
 - 2) Gemco.
 - 3) Midwest Fasteners, Inc.
 - 4) Nelson Stud Welding.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- B. Wire: 0.062-inch soft-annealed, stainless steel.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C & F Wire.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. RPR Products, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket .
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Provide vapor barrier and seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
- J. Apply adhesives, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
 - 2. Cover circumferential joints with 3-inch-wide strips of same material as insulation jacket. Secure strips with adhesive.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
- L. Cut insulation in a manner to avoid compressing insulation.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere and seal patches similar to butt joints.

3.4 PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
 1. Comply with requirements in Section 23 00 10 "General Requirement for HVAC."
- C. Insulation Installation at Floor Penetrations:
 1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 23 00 10 "General Requirement for HVAC."

3.5 INSTALLATION OF GLASS-FIBER INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with insulation pins and wire and adhesive.
- B. Comply with manufacturer's written installation instructions.
 1. Install cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 2. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section. Install vapor barrier consisting of factory-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

- a. Repair punctures, tears, and penetrations with tape to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
 - 3. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
 - 4. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 - 5. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- C. Board Insulation Installation on Ducts and Plenums: Secure with insulation pins.
- 1. Install cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 - 2. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment.. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
 - 3. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 - 4. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.6 DUCT INSULATION SCHEDULE, GENERAL

- A. Ductwork and Plenum Insulation: As scheduled on Drawings.

- B. Items Not Insulated:
1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
 2. Factory-insulated flexible ducts.
 3. Factory-insulated plenums and casings.
 4. Flexible connectors.
 5. Vibration-control devices.
 6. Factory-insulated access panels and doors.

END OF SECTION

SECTION 23 07 19

HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulation for HVAC piping systems.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied, if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or craft training program, certified by the Department of Labor, Bureau of Apprenticeship and Training.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation system materials are to be delivered to the Project site in unopened containers. The packaging is to include name of manufacturer, fabricator, type, description, and size, as well as ASTM standard designation, and maximum use temperature.

1.5 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.6 SCHEDULING

- A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84 by a testing agency acceptable to authority having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule" shown on Drawings.
- B. Products do not contain asbestos, lead, mercury, or mercury compounds.
- C. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.
- D. Flexible Elastomeric: Closed-cell, or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534/C534M, Type I, for tubular materials, Type II for sheet materials.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA, Inc.
 - b. Armacell LLC.
 - c. K-Flex USA.
- E. Glass-Fiber, Preformed Pipe: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 850 deg F in accordance with ASTM C411. Comply with ASTM C547.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. Knauf Insulation.
 - c. Manson Insulation Inc.
 - d. Owens Corning.
 2. Preformed Pipe Insulation: Type I, Grade A] with factory-applied ASJ-SSL.
 3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
 4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- F. Glass-Fiber, Pipe and Tank: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 850 deg F, in accordance with ASTM C411. Comply with ASTM C1393.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation; Saint-Gobain North America.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Manson Insulation Inc.
 - e. Owens Corning.
 2. Semirigid board material with factory-applied ASJ jacket.
 3. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.3 ADHESIVES

- A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Flexible Elastomeric Adhesive: Solvent-based adhesive.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA.
 - b. Armacell LLC.

- c. K-Flex USA.
 - 2. Flame-spread index is 25 or less and smoke-developed index is 50 or less as tested in accordance with ASTM E84.
 - 3. Wet Flash Point: Below 0 deg F.
 - 4. Service Temperature Range: 40 to 200 deg F.
 - 5. Color: Black.
- C. Glass-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller Construction Products.
 - c. Mon-Eco Industries, Inc.
- D. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller Construction Products.
 - c. Mon-Eco Industries, Inc.
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. P.I.C. Plastics, Inc.
 - c. Proto Corporation.
 - d. Speedline Corporation.
 - e. The Dow Chemical Company.
 - f. Voltek; a division of Sekisui America Corp.

2.4 SEALANTS

- A. Materials are as recommended by the insulation manufacturer and are compatible with insulation materials, jackets, and substrates.
- B. Joint Sealants:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller Construction Products.
 - c. Mon-Eco Industries, Inc.
 - d. Owens Corning.
 - 2. Permanently flexible, elastomeric sealant.
 - a. Service Temperature Range: Minus 150 to plus 250 deg F.
 - b. Color: White or gray.
- C. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller Construction Products.
 - 2. Fire- and water-resistant, flexible, elastomeric sealant.
 - 3. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 4. Color: White.

2.5 FACTORY-APPLIED JACKETS

- A. Insulation systems below indicate factory-applied jackets on various applications. Factory-applied jackets shall include vapor-barrier systems for all below-ambient-temperature applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.

2.6 FIELD-APPLIED JACKETS

- A. Field-applied jackets comply with ASTM C1136, Type I, unless otherwise indicated.
- B. Metal Jacket:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. RPR Products, Inc.
 2. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper or 3-mil-thick polysurlyn.
 - d. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.7 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Industrial Adhesives and Tapes Division.
 - b. Avery Dennison Corporation, Specialty Tapes Division.
 - c. Ideal Tape Co., Inc., an American Biltrite Company.
 - d. Knauf Insulation.
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.
- D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with the Contract Documents.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Provide vapor barrier for all below-ambient services. Seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic. Wrap all protrusions of the vapor barrier for a continuous system without breaks.
 - 1. Install insulation continuously through hangers and around anchor attachments.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.

2. Cover circumferential joints with 3-inch-wide strips of same material as insulation jacket. Secure strips with adhesive.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap.
 4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere and seal patches in similar fashion to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 23 00 10 "General Requirements for HVAC" for firestopping and fire-resistive joint sealers.
- D. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 23 00 10 "General Requirements for HVAC."

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles below.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using prefabricated fitting insulation and fitting covers made from same material and density as that of adjacent pipe insulation. Each piece is butted tightly against adjoining piece and bonded with adhesive.
 3. Insulate tee fittings with prefabricated fitting insulation and fitting covers of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using prefabricated fitting insulation and fitting covers of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate flanges, mechanical couplings, and unions using a section of oversized preformed pipe insulation to fit. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
 6. Install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape to maintain vapor barrier on cold services.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with fitting covers.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install sections of pipe insulation and miter if required in accordance with manufacturer's written instructions.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install prefabricated valve covers manufactured of same material as that of pipe insulation when available.
 2. When prefabricated valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF GLASS-FIBER INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire, and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions.
 3. For insulation with jackets on below-ambient surfaces:
 - a. Secure tabs with additional adhesive, as recommended by insulation material manufacturer.
 - b. Seal with vapor-barrier sealant.
 - c. In every 20 feet of straight piping, provide a Z-channel vapor stop.
 - d. Liberally apply vapor-barrier sealant to the cut ends of all pipe insulation section. In addition, apply sealant to adjacent pipe and mechanical couplings for a complete vapor seal.
- B. Insulation Installation on Pipe Flanges:
1. Install prefabricated pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with glass-fiber or mineral-wool blanket insulation.
 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
 2. When prefabricated sections are not available, install fabricated sections of pipe insulation to valve body.
 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 4. Install insulation to flanges as specified for flange insulation application.

3.8 INSTALLATION OF FIELD-APPLIED JACKETS

- A. Removable / reusable wraps:
1. Install in accordance with manufacturer's recommendations.
- B. Where PVC jackets are indicated and for horizontal applications, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

- C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

3.9 FINISHES

- A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- B. Do not field paint aluminum jackets.

3.10 PIPING INSULATION SCHEDULE, GENERAL

- A. Insulation conductivity and thickness per pipe size comply with schedules on the Drawings or with requirements of authorities having jurisdiction, whichever is more stringent.
- B. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range scheduled on the Drawings. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

3.11 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Refrigerant Piping from curb to roof-mounted units:
 - 1. Aluminum, Smooth: 0.024 inch thick.

END OF SECTION

SECTION 23 09 00

INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes Direct Digital Controls and devices for HVAC systems and components.
- B. All NEW HVAC Controls shall be Trane Tracer as purchased by the District directly through the Omnia Cooperative.

1.2 ACTION SUBMITTALS

- A. Product Data: For each control device indicated.
- B. Shop Drawings:
 - 1. Schematic flow diagrams.
 - 2. Power, signal, and control wiring diagrams.
 - 3. Details of control panel faces.
 - 4. Damper schedule.
 - 5. Valve schedule.
 - 6. DDC System Hardware: Wiring diagrams, schematic floor plans, and schematic control diagrams.
 - 7. Control System Software: Schematic diagrams, written descriptions, and points list.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
- B. Software and firmware operational documentation.

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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. This section is included for reference and information only. The District is purchasing the temperature control system from Trane on NYS contract."
- B. Trane Tracer SC+; Air-fi Wireless & BACnet(UC) Web-Based DDC System
 - 1. Contact: Ray Spears 315-234-1537

2.2 CONTROL SYSTEM

- A. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.

- B. Control system shall consist of Web-Based Building controller, sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.
- C. The Controls Contractor shall provide all communication media, connectors, repeaters and network switches routers necessary for the high speed Ethernet communications network.
- D. The Owner will provide all communication media, connectors, repeaters, network switches, and routers necessary for the high speed Ethernet network. An active Ethernet port will be provided adjacent to each System Controller and operator interface (PC) for connection to this high speed Ethernet network.

2.3 DDC EQUIPMENT

- A. This project shall comprise of a network utilizing high-speed BACnet IP for communications between System Controllers. BACnet MS/TP or BACnet ZigBee Wireless sub-networks shall be used for communications between System Controllers, Custom Application Controllers and Application Specific Controllers.
- B. Each System Controller shall perform communications to a network of Custom Application and Application Specific Controllers using BACnet/MSTP (RS485) as prescribed by the BACnet standard.
- C. Each System Controller shall function as a BACnet Router to each unit controller providing a unique BACnet Device ID for all controllers within the system.
- D. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory.
 - 1. Units 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.
 - 2. Stand-alone mode control functions 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.
- E. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
 - 1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
 - 2. Stand-alone mode control functions 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.
 - 3. Local operator interface provides for download from or upload to operator workstation.
- F. 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).
 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.
- G. 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 overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.
- H. 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.

2.4 UNITARY CONTROLLERS

- A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
1. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostics; monitor system and report failures.
 2. Enclosure: Dustproof rated for operation at 32 to 120 deg F.
 3. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.
- B. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
- C. IEEE 802.15.4 radios to minimize risk of interference and maximize battery life, reliability, and range.
- D. Operating range shall be a minimum of 200 feet; open range shall be 2,500 ft. (762 m) with less than 2% packet error rate.
- E. To maintain robust communication, mesh networking and two-way communications shall be used to optimize the wireless network health.
- F. Certifications shall include FCC CFR47 - RADIO FREQUENCY DEVICES - Section 15.247 & Subpart E.
- G. Shall be ZigBee Building Automation Certified to allow wireless integration with products from multiple suppliers.

2.5 ELECTRONIC SENSORS

- A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

- B. Thermistor Temperature Sensors and Transmitters:
 - 1. Accuracy: Plus or minus 0.5 deg F at calibration point.
 - 2. Wire: Twisted, shielded-pair cable.
 - 3. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
 - 4. Averaging Elements in Ducts: 36 inches long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft.
 - 5. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
 - 6. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - a. Set-Point Adjustment: Concealed.
 - b. Set-Point Indication: Concealed.
 - c. Thermometer: None.
 - d. Orientation: Vertical.
 - 7. Outdoor-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
 - 8. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

- C. RTDs and Transmitters:
 - 1. Accuracy: Plus or minus 0.2 percent at calibration point.
 - 2. Wire: Twisted, shielded-pair cable.
 - 3. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
 - 4. Averaging Elements in Ducts: 18 inches long, rigid; use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; length as required.
 - 5. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
 - 6. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - a. Set-Point Adjustment: Concealed.
 - b. Set-Point Indication: Concealed.
 - c. Thermometer: None.
 - d. Orientation: Vertical.
 - 7. Outdoor-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
 - 8. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

- D. Pressure Transmitters/Transducers:
 - 1. Static-Pressure Transmitter: Non-directional sensor with suitable range for expected input, and temperature compensated.
 - a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
 - b. Output: 4 to 20 mA.
 - c. Building Static-Pressure Range: 0- to 0.25-inch wg.
 - d. Duct Static-Pressure Range: 0- to 5-inch wg.
 - 2. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA.
 - 3. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig; linear output 4 to 20 mA.
 - 4. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
 - 5. Pressure Transmitters: Direct acting for gas or liquid service; range suitable for system; linear output 4 to 20 mA.

- E. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 1. Set-Point Adjustment: Concealed.
 2. Set-Point Indication: Concealed.
 3. Thermometer: None.
 4. Orientation: Vertical.
- F. Room sensor accessories include the following:
 1. Insulating Bases: For sensors located on exterior walls.
 2. Guards: Locking; heavy-duty, transparent plastic; mounted on separate base for all public areas.
 3. Adjusting Key: As required for calibration and cover screws.

2.6 STATUS SENSORS

- A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg.
- B. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.
- C. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.
- D. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.
- E. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

2.7 THERMOSTATS

- 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.
 2. Selector Switch: Integral, manual on-off-auto.
- C. Room Thermostat Cover Construction: Manufacturer's standard locking covers.
 1. Set-Point Adjustment: Concealed.
 2. Set-Point Indication: Concealed.
 3. Thermometer: None.
 4. Orientation: Vertical.
- D. Room thermostat accessories include the following:
 1. Insulating Bases: For thermostats located on exterior walls.
 2. Thermostat Guards: Locking; heavy-duty, transparent plastic; mounted on separate base for all public areas.
 3. Adjusting Key: As required for calibration and cover screws.
 4. Set-Point Adjustment: 1/2-inch-diameter, adjustment knob.
- E. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.

- F. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type; with adjustable set point in middle of range, adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.
- G. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.
 - 1. Bulb Length: Minimum 20 feet.
 - 2. Quantity: One thermostat for every 20 sq. ft. of coil surface.

2.8 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
 - 1. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
 - 2. Non-Spring-Return Motors for Valves Larger than NPS 2-1/2: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 - 3. Spring-Return Motors for Valves Larger than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf.
 - 4. Non-Spring-Return Motors for Dampers Larger than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 - 5. Spring-Return Motors for Dampers Larger than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.
- B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
 - 1. Valves: Size for torque required for valve close off at maximum pump differential pressure.
 - 2. Dampers: Size for running torque calculated as follows:
 - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
 - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
 - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. of damper.
 - d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
 - e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
 - f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.
 - 3. Coupling: V-bolt and V-shaped, toothed cradle.
 - 4. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
 - 5. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on non-spring-return actuators.
 - 6. Power Requirements (Two-Position Spring Return): 24-V ac.
 - 7. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
 - 8. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
 - 9. Temperature Rating: Minus 22 to plus 122 deg F.

2.9 DAMPERS

- A. Dampers: AMCA-rated, parallel- or opposed-blade design; 0.108-inch-minimum thick, 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 galvanized steel with maximum blade width of 8 inches and length of 48 inches.

1. Secure blades to 1/2-inch-diameter, zinc-plated axles using zinc-plated hardware, with oil-impregnated sintered bronze or nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
2. Operating Temperature Range: From minus 40 to plus 200 deg F.
3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
4. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is held by torque of 50 in. x lbf; when tested according to AMCA 500D.

2.10 CONTROL CABLE

- A. Plenum-rated electronic and fiber-optic cables for control wiring.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation. Install devices 60 inches above the floor.
 1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- B. Install guards on thermostats in the following locations:
 1. Public areas.
- C. Furnish automatic dampers for installation by Sheet Metal Subcontractor. Coordinate work.
- D. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- E. Install labels and nameplates to identify control components.

3.2 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Where subject to abuse, all Class 11 wiring for remote-control low-voltage power in a signal circuit shall be installed in thin-wall electrical metallic tubing (EMT). Where concealed in plenum space, provide plenum-rated cable, properly supported.
- B. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- C. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
 2. Test and adjust controls and safeties.
 3. Test calibration of controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
 4. Test each point through its full operating range to verify that safety and operating control set points are as required.

5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
 6. Test each system for compliance with sequence of operation.
 7. Test software and hardware interlocks.
- B. 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 pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
 6. Check temperature instruments and material and length of sensing elements.
 7. Check control valves. Verify that they are in correct direction.
 8. 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.
 - c. Verify that spare I/O capacity has been provided.
 - d. Verify that DDC controllers are protected from power supply surges.
- C. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.4 DEMONSTRATION

- A. Provide minimum of (1) on-site training sessions, and (2) hours for each session, throughout the contract period and one(1) final 4-hour session, 3 months after project substantial completion. The training will be provided for personnel designated by the Owner.
- B. The Owner training shall enable personnel to proficiently operate the BAS by being able to create, modify and delete programming; add, remove and modify physical points for individual controllers; and add additional controllers when required.
- C. These objectives will be divided into three logical groupings; participants may attend one or more of these, depending on level of knowledge required:
- D. Day-to-day BAS Operators
- E. BAS Troubleshooting & Maintenance
- F. Maintenance Manager: Parts Inventory
- G. Provide course outline and materials prior to schedule training session. The instructor(s) shall provide one copy of training material per student.
- H. The instructor(s) shall be factory-trained and experienced in teaching this technical material.
- I. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls.

3.5 SEQUENCES OF OPERATION— LOWVILLE ACADEMY & CENTRAL SCHOOL

- A. Rooftop Unit RTU-1 Control:
1. RTU-1 serves HS & MS Technology rooms and has DX cooling, outside- and return-air dampers, heat-recovery and economizer sections, gas furnace heating section, and supply fan. A DDC controller interfaces to the rooftop. The space served by the rooftop unit is controlled as follows:
 - a. Occupied Mode: The fan is on, and the outside- and relief-air dampers are controlled. Outside- and relief-air dampers are open to minimum position and the unit is providing full outdoor airflow as scheduled. The DDC controllers stage gas heating section, economizer section, and cooling section in sequence to maintain room temperature at set point.
 - b. Free Cooling: If outdoor-air conditions are such that fresh air can be used to cool the space, the controller shall enable free cooling. Cooling section and the furnace section shall be off. Outdoor-air and exhaust-air dampers open fully upon call for free cooling. The RTU shall not discharge inordinately low-temperature air. Economizer operation shall be shown on the DDC network and alarm provided when economizer does not operate correctly in accordance with NYS Code requirements.
 - c. Unoccupied Mode: The fan operates intermittently to maintain reduced or increased night heating/cooling set points. Outside- and relief-air dampers are closed.
 - d. Safety Mode:
 - 1) The DDC controller shall monitor the following:
 - a) Supply-fan status via current sensor.
 - b) Supply-air temperature.
 - c) DDC shall monitor the economizer cycle in accordance with NYS Code requirements and alarm on network when economizer cycle is non-functional.
- B. Variable-Refrigerant-Flow (VRF) System Control—Serving Nurse and Office spaces:
1. DDC controllers shall interface with VRF-system BACNet interface.
 2. Wall-mounted sensor shall cycle the VRF-system fan to maintain the space temperature at set point.
 3. Provide temperature indication on DDC network.
 4. Associated ACCU will operate to provide cooling and heating as indexed by the VRF system.
- C. Radiant Ceiling Panel ("RCP") Control:
1. Radiant ceiling panel is controlled by a DDC controller using electric actuation. The space served by the RCP is controlled in the modes as follows:
 - a. Occupied Mode: The controller monitors the room-temperature sensor and modulates the control valve to maintain the space temperature at set point.
 - b. Unoccupied Mode: The radiant ceiling panel is controlled using the unoccupied space-temperature set point. The controller may reset to the occupied mode for a predetermined time period upon a signal from the control system or manually at the room sensor.
- D. DOAS / Heat Recovery Unit (HRU) Control:
1. HRU serves VRF system and has a heat-recovery section; outside-air, bypass, and exhaust-air dampers; and supply and exhaust fans. A DDC controller interfaces to the DOAS / HRU. The spaces served by the unit are controlled in the modes as follows and unit provides full outdoor air ventilation during occupied times.
 2. Occupied Mode: The fans are on, and the outside- and exhaust-air dampers are open. The coil valve is modulated to maintain discharge-air temperature set point. Discharge-air set point is reset based on space temperature.

3. Unoccupied Mode: HRU is off. The supply and exhaust fans are off, and outdoor-air/exhaust-air dampers are closed. VRF operates without outdoor air to maintain unoccupied space temperatures.
4. Safety Mode:
 - a. A low-temperature detector in the discharge airstream de-energizes the unit fan when temperatures below 38 degrees F.
 - b. All dampers and valves position to their fail-safe position.

3.6 SEQUENCES OF OPERATION— LOWVILLE A&CS BUS GARAGE

- A. Heat Recovery Unit (HRU) Control:
 1. HRU serving individual spaces has a heat-recovery section; outdoor-air, bypass, recirculation, and exhaust-air dampers; supply and exhaust fans; and a unit-mounted, gas-fired heating furnace section. A DDC controller interfaces to the HRU controls. The space served by the unit is controlled in the modes as follows:
 - a. Recirculation damper is closed during occupied times, providing full ventilation volume.
 - b. Occupied Mode: The fans are on, and the outdoor- and exhaust-air dampers are open. The furnace section output is modulated to maintain discharge-air temperature set point. Discharge-air set point is reset based on space temperature.
 - c. Free Cooling: If outdoor-air conditions are such that fresh air can be used to cool the space, the controller shall enable free cooling. The heat-recovery bypass damper shall open, and the furnace section shall be off. Outdoor-air and exhaust-air dampers open fully, and recirculation-air dampers close upon call for free cooling. The HRU shall not discharge inordinately low-temperature air. Economizer operation shall be shown on the DDC network and alarm provided when economizer does not operate correctly in accordance with NYS Code requirements.
 - d. Unoccupied Mode: The HRU is controlled using the unoccupied space-temperature set point. The supply and exhaust fans are off, outdoor-air/exhaust-air dampers are closed, recirculation damper is open, and furnace section is off. If unoccupied heating is required, overhead radiant heaters shall operate until heating set point cannot be met. Then HRU supply fan is enabled, recirculation damper remains open, and furnace section shall operate. Outdoor-air/exhaust-air dampers remain closed. The controller may reset to the occupied mode for a predetermined time period upon a signal from the control system or manually at the room sensor.
 - e. Provide space-temperature indication on DDC network.
 - f. Safety Mode:
 - 1) A low-temperature detector in the discharge airstream de-energizes the unit fan when temperatures below 38 deg F.
 - 2) All dampers and valves position to their fail-safe position.

END OF SECTION

SECTION 23 21 13

HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Copper tube and fittings.
 - 2. Steel pipe and fittings.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tube: ASTM B88, Type L.
- B. Annealed-Temper Copper Tube: ASTM B88, Type K.
- C. Copper or Bronze Pressure-Seal Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkhart Products Corporation.
 - b. NIBCO INC.
 - c. Viega LLC.
 - d. Apollo Xpress
 - 2. Housing: Copper.
 - 3. O-Rings and Pipe Stops: EPDM.
 - 4. Tools: Manufacturer's special tools.
 - 5. Minimum 200-psig working-pressure rating at 250 deg F
- D. Cast-Copper, Solder-Joint Fittings: ASME B16.18 pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.
- E. Wrought-Copper, Solder-Joint Fittings: ASME B16.22 pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.
- F. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Do not use solder joints on pipe sizes greater than NPS 4.
- G. Cast-Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends. Do not use solder joints on pipe sizes greater than NPS 4.
- H. Wrought-Copper Unions: ASME B16.22. Do not use solder joints on pipe sizes greater than NPS 4.
- I. Grooved, Mechanical-Joint, Copper Tube Appurtenances:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International/Smith-Cooper International; Tailwind Capital, LLC.
 - b. Shurjoint; a part of Aalberts Integrated piping Systems.
 - c. Smith-Cooper International.
 - d. Star Pipe Products.
 - e. Victaulic Company.

2. Grooved-End Copper Fittings: ASTM B75 copper tube or ASTM B584 bronze castings.
3. Grooved-End-Tube Couplings: To fit copper-tube dimensions; rigid pattern unless otherwise indicated; gasketed fitting EPDM gasket rated for minimum 230 deg F for use with ferrous housing, and steel bolts and nuts; 300 psig minimum CWP pressure rating.

2.2 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A53/A53M black steel with plain ends; welded and seamless, Grade B, and schedule number as indicated in Part 3, "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3, "Piping Applications" Article.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3, "Piping Applications" Article.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3, "Piping Applications" Article.
- E. Steel Pipe Nipples: ASTM A733, made of same materials and wall thicknesses as pipe in which they are installed.

2.3 PIPING JOINING MATERIALS

- A. Solder Filler Metals: ASTM B32, lead-free alloys.
- B. Flux: ASTM B813, water flushable.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Water/Glycol Piping, Aboveground, NPS 2 and Smaller, to Be Any of the Following:
 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or pressure-sealed joints.
 2. Schedule 40, Grade B, steel pipe; Class 125, cast-iron fittings; and threaded joints.
- B. Air-Vent Piping:
 1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems, according to piping manufacturer's written instructions.
 2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

3.2 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- K. Install drains, consisting of a tee fitting, ball valve, and short threaded nipple with hose end and cap, at low points in piping system mains and elsewhere as required for system drainage.
- L. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- M. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- N. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- O. Install valves according to the following:
 - 1. Section 23 05 23.12 "Ball Valves for HVAC Piping."
- P. Install air vents and pressure-relief valves in accordance with Section 23 21 16 "Hydronic Piping Specialties."
- Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Install shutoff valve immediately upstream of each dielectric fitting.
- S. Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for identifying piping.

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Apply ASTM B813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints in accordance with ASTM B828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B32.
- D. Brazed Joints: Construct joints in accordance with AWS's "Brazeing Handbook," "Pipe and Tube" chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.

- E. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- F. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

3.4 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.
- B. Install hangers for copper tubing and steel piping, with maximum horizontal spacing and minimum rod diameters, to comply with NYS Mechanical Code (based on IMC 2020), MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Support horizontal piping within 12 inches of each fitting and coupling.
- D. Support vertical runs of copper tubing and steel piping to comply with NYS Mechanical Code (based on IMC 2020), MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.5 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections are to be as shown on Drawings.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install ports for pressure gauges and thermometers at coil inlet and outlet connections. Comply with requirements in Section 23 05 19 "Meters and Gauges for HVAC Piping."

3.6 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 23 05 53 "Identification for HVAC Piping and Equipment."

3.7 SYSTEM STARTUP

- A. Perform the following before operating the system:
 - 1. Open manual valves fully.
 - 2. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 - 3. Set temperature controls so all coils are calling for full flow.
 - 4. Verify lubrication of motors and bearings.
 - 5. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.
 - 6. Assist Owner's water treatment consultant with installing chemicals.

3.8 FIELD QUALITY CONTROL

- A. Prepare hydronic piping in accordance with ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure is to be capable of sealing against test pressure without damage to valve.
 5. Install pressure-relief valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform one of the following tests on hydronic piping:
1. Hydrostatic Test Pressure:
 - a. Use ambient-temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 - b. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 - c. Isolate expansion tanks and determine that hydronic system is full of water.
 - d. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure is not to exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9.
 - e. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 2. Compressed-Air Test Pressure:
 - a. Use compressed air as a testing medium. Isolate any equipment that would be impacted by excessive pressures.
 - b. Subject piping system to air test pressure of 80-100 psi. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength.
 - c. After air test pressure has been applied for at least 8 hours, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat test until there are no leaks.
 3. Prepare written report of testing.

END OF SECTION

SECTION 23 21 16

HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Hydronic specialty valves.
 - 2. Air vents.

1.2 ACTION SUBMITTALS

- A. Product Data.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data manuals.

PART 2 - PRODUCTS

2.1 HYDRONIC SPECIALTY VALVES

- A. Bronze, Calibrated-Orifice, Balancing Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong Fluid Technology.
 - b. Bell & Gossett; a Xylem brand.
 - c. Taco Comfort Solutions.
 - 2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
 - 3. Ball: Brass or stainless steel.
 - 4. Plug: Resin.
 - 5. Seat: PTFE.
 - 6. End Connections: Threaded or socket.
 - 7. Pressure Gauge Connections: Integral seals for portable differential pressure meter.
 - 8. Handle Style: Lever, with memory stop to retain set position.
 - 9. CWP Rating: Minimum 125 psig.
 - 10. Maximum Operating Temperature: 250 deg F.
 - 11. Provide shutoff-duty valve.

2.2 AIR VENTS

- A. Manual Air Vents:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bell & Gossett; a Xylem brand.
 - b. Armstrong Fluid Technology.
 - c. Taco Comfort Solutions.
 - d. WATTS.
 - 2. Body: Bronze.
 - 3. Internal Parts: Nonferrous.
 - 4. Operator: Screwdriver or thumbscrew.
 - 5. Inlet Connection: NPS 1/2.
 - 6. Discharge Connection: NPS 1/8.
 - 7. CWP Rating: 150 psig.
 - 8. Maximum Operating Temperature: 225 deg F.

PART 3 - EXECUTION

3.1 INSTALLATION OF VALVES

- A. Install calibrated-orifice balancing valve as shown on Drawings and Details.

3.2 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
 - 1. Provide air outlet drain line full size of air outlet to floor drain or to other point indicated on Drawings.
- B. Install manual vents at heat-transfer coils and elsewhere as required for air venting.

END OF SECTION

SECTION 23 31 13

METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Single-wall rectangular ducts and fittings.
 - 2. Single-wall round ducts and fittings.
 - 3. Sheet metal materials.
 - 4. Duct liner.
 - 5. Sealants and gaskets.
 - 6. Hangers and supports.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Liners and adhesives.
 - 2. Sealants and gaskets.
- B. Shop Drawings:
 - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 - 2. Factory- and shop-fabricated ducts and fittings.
 - 3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
 - 4. Elevation of bottom of ducts.
 - 5. Fittings.
 - 6. Reinforcement and spacing.
 - 7. Seam and joint construction.
 - 8. Penetrations through fire-rated and other partitions.
 - 9. Equipment installation based on equipment being used on Project.
 - 10. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
 - 11. Hangers and supports, including methods for duct and building attachment and vibration isolation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."
- D. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

- E. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
 - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
- B. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
 - 2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
- C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." All longitudinal seams shall be Pittsburgh lock seams unless otherwise specified for specific application.
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 1. Construct ducts of galvanized sheet steel including ducts exposed to weather unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing

requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
 - 3.
- C. Reinforcement Shapes and Plates: ASTM A36/A36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- D. Tie Rods: Galvanized steel, 1/4-inch-minimum diameter for lengths 36 inches or less; 3/8-inch-minimum diameter for lengths longer than 36 inches.

2.5 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Certaineed; SAINT-GOBAIN.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Owens Corning.
 - 2. Maximum Thermal Conductivity:
 - a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - 3.
 - 4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C916.
- B. Insulation Pins and Washers:
 - 1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel, aluminum, or stainless steel; with beveled edge sized as required to hold insulation securely in place, but not less than 1-1/2 inches in diameter.
- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
 - 1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.

2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm or greater.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.
 - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
 - a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.6 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
- B. Water-Based Joint and Seam Sealant:
 1. Application Method: Brush on.
 2. Solids Content: Minimum 65 percent.
 3. Shore A Hardness: Minimum 20.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. VOC: Maximum 75 g/L (less water).
 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 8. Service: Indoor or outdoor.
 9. Substrate: Compatible with galvanized sheet steel sheets.
 10. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
 11. Service: Indoor or outdoor.
 12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- C. Flanged Joint Sealant: Comply with ASTM C920.
 1. General: Single-component, acid-curing, silicone, elastomeric.
 2. Type: S.
 3. Grade: NS.
 4. Class: 25.
 5. Use: O.

- D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.7 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.
- B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.
- D. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- F. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.
- B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install ducts in maximum practical lengths with fewest possible joints.
- D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- H. Route ducts to avoid passing through stairs, transformer vaults, and electrical equipment rooms and enclosures. Also route to avoid passing under or over electrical panels.
- I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

- J. Install fire dampers where indicated on Drawings. Comply with requirements in Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the damper UL listing.
- K. Install duct-mounted accessories in air ducts as indicated on Drawings.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
- M. Elbows: Use long-radius elbows wherever they fit.
 1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
 2. Fabricate 90-degree round elbows with a minimum of three segments for 12 inches and smaller and a minimum of five segments for 14 inches and larger.
- N. Branch Connections: Use lateral or conical branch connections.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 1. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 2. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 3. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 23 33 00 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.4 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Duct System Cleanliness Tests:
 - 1. Visually inspect duct system to ensure that no visible contaminants are present.
- C. Duct system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.6 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
 - 1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.
- B. All Ducts:
 - 1. Ducts Connected to Constant-Volume Air-Handling Units:
 - a. Pressure Class: Positive 2-inch wg.
- C. Intermediate Reinforcement:
 - 1. Galvanized-Steel Ducts: Galvanized steel, carbon steel coated with zinc-chromate primer, or galvanized steel or carbon steel coated with zinc-chromate primer.
- D. Liner:
 - 1. All lined ducts as shown on Drawings: Fibrous glass, Type I, 1 inch thick.
- E. Elbow Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - 2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or welded.
- F. Branch Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.

- b. Rectangular Main to Round Branch: Conical spin in.
2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
- a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION

SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Manual volume dampers.
 - 2. Fire dampers.
 - 3. Flange connectors.
 - 4. Turning vanes.
 - 5. Duct-mounted access doors.
 - 6. Duct accessory hardware.
 - 7. Roof equipment curbs.
 - 8. Roof curbs for pipe/conduit flashings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details, and attachments to other work.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 90A and NFPA 90B.
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance; a division of MESTEK, Inc.
 - b. Aire Technologies.
 - c. American Warming and Ventilating; a Mestek Architectural Group company.
 - d. Arrow United Industries.
 - e. Cesco Products; a division of MESTEK, Inc.
 - f. Greenheck Fan Corporation.
 - g. Lloyd Industries, Inc.
 - h. McGill AirFlow LLC.
 - i. Nailor Industries Inc.
 - j. Pottorff.
 - k. Ruskin Company.

- l. Safe Air - Dowco Products.
 - m. United Enertech.
 - n. Vent Products Co., Inc.
 - 2. Performance:
 - a. Leakage Rating Class III: Leakage not exceeding 40 cfm/sq. ft. against 1-inch wg differential static pressure.
 - 3. Construction:
 - a. Linkage out of airstream.
 - b. Suitable for horizontal or vertical airflow applications.
 - 4. Frames:
 - a. Hat-shaped, 16-gauge-thick, galvanized sheet steel.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized steel; 16-gauge thick.
 - 6. Blade Axles: Galvanized steel, stainless steel, or nonferrous metal.
 - 7. Bearings:
 - a. Oil-impregnated bronze, molded synthetic, oil-impregnated stainless-steel sleeve, or stainless-steel sleeve.
 - b. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.
 - 8. Tie Bars and Brackets: Galvanized steel.
 - 9. Locking device to hold damper blades in a fixed position without vibration.
- B. Jackshaft:
- 1. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 - 2. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- C. Damper Hardware:
- 1. Zinc-plated, die-cast core with dial and handle, made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
 - 2. Include center hole to suit damper operating-rod size.
 - 3. Include elevated platform for insulated duct mounting.

2.3 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. Air Balance; a division of MESTEK, Inc.
 - 2. Aire Technologies.
 - 3. Arrow United Industries.
 - 4. Cesco Products; a division of MESTEK, Inc.
 - 5. CL WARD & Family Inc.
 - 6. Greenheck Fan Corporation.
 - 7. NCA Manufacturing, Inc.
 - 8. Pottorff.
 - 9. Prefco.
 - 10. Ruskin Company.
 - 11. Safe Air - Dowco Products.
 - 12. United Enertech.
 - 13. Vent Products Co., Inc.
- B. Type: Static; rated and labeled in accordance with UL 555 by an NRTL.

- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.
- D. Fire Rating: 1-1/2 hours.
- E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed galvanized steel; with mitered and interlocking corners; gauge in accordance with UL listing.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel; gauge in accordance with UL listing.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed galvanized sheet steel, interlocking full-length steel blade connectors. Material gauge is to be in accordance with UL listing.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device:
 - 1. Replaceable, 165 deg F rated, fusible links.

2.4 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CL WARD & Family Inc.
 - 2. Ductmate Industries, Inc.
 - 3. DynAir; a Carlisle Company.
 - 4. Elgen Manufacturing.
 - 5. Ward Industries; a brand of Hart & Cooley, Inc.
- B. Description: Add-on or roll-formed, factory fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gauge and Shape: Match connecting ductwork.

2.5 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Aero-Dyne Sound Control Co.
 - 2. CL WARD & Family Inc.
 - 3. Ductmate Industries, Inc.
 - 4. Duro Dyne Inc.
 - 5. DynAir; a Carlisle Company.
 - 6. Elgen Manufacturing.
 - 7. Ward Industries; a brand of Hart & Cooley, Inc.
- B. Manufactured Turning Vanes for Metal Ducts: Fabricate curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
 - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 4-3, "Vaness and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
- D. Vane Construction:
 - 1. Double wall.

2.6 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Aire Technologies.
 - 2. Arrow United Industries.
 - 3. Cesco Products; a division of MESTEK, Inc.
 - 4. CL WARD & Family Inc.
 - 5. Ductmate Industries, Inc.
 - 6. Duro Dyne Inc.
 - 7. Elgen Manufacturing.
 - 8. Flexmaster U.S.A., Inc.
 - 9. McGill AirFlow LLC.
 - 10. Ruskin Company.
 - 11. United Enertech.
 - 12. Ventfabrics, Inc.
 - 13. Ward Industries; a brand of Hart & Cooley, Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 7-2 (7-2M), "Duct Access Doors and Panels," and Figure 7-3, "Access Doors - Round Duct."
 - 1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. 24-gauge-thick galvanized steel or 0.032-inch-thick aluminum or 24-gauge-thick stainless steel door panel.
 - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - e. Fabricate doors airtight and suitable for duct pressure class.
 - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - a. 24-gauge-thick galvanized steel or 0.032-inch-thick aluminum frame.
 - 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges or continuous and two compression latches with outside and inside handles.
 - d. Access Doors Larger Than 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.

2.7 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CL WARD & Family Inc.
 - 2. Ductmate Industries, Inc.
 - 3. Duro Dyne Inc.
 - 4. DynAir; a Carlisle Company.
 - 5. Elgen Manufacturing.
 - 6. Ventfabrics, Inc.
 - 7. Ward Industries; a brand of Hart & Cooley, Inc.

- B. Fire-Performance Characteristics: Adhesives, sealants, fabric materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested in accordance with ASTM E84.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Materials: Flame-retardant or noncombustible fabrics.
- E. Coatings and Adhesives: Comply with UL 181, Class 1.
- F. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.
- G. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd..
 - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F.

2.8 DUCT ACCESSORY HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CL WARD & Family Inc.
 - 2. Ductmate Industries, Inc.
 - 3. Duro Dyne Inc.
 - 4. DynAir; a Carlisle Company.
 - 5. Elgen Manufacturing.
 - 6. Hardcast; a Carlisle Company.
 - 7. United Enertech.
 - 8. Ventfabrics, Inc.
 - 9. Ward Industries; a brand of Hart & Cooley, Inc.
- B. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- C. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.9 ROOF EQUIPMENT CURBS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Pate Products.
 - 2. RPS.
 - 3. Greenheck.
- B. Provide prefabricated roof curbs to support roof-mounted equipment.
- C. Double shell, 2-inch-thick, 2- x 2-inch wood nailer, insulated, braced, pitched, and extended as required with built-in cant strip where required for compatibility with roofing system
- D. Equipment Support Curbs
 - 1. Galvanized steel construction with continuous wood nailer. Minimum height: 18 inches.

- 2. Mitered and welded corner seams, integral base plate, and galvanized steel counter flashing.
 - 3. Compatible with roofing and roofing-insulation type. Coordinate with General Contractor.
- E. Insulation shall be rigid type, R=10 minimum.
 - F. Provide rubber gasket on top of curb to make airtight seal.

2.10 ROOF CURBS FOR PIPE/CONDUIT FLASHINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Pate Products.
 - 2. RPS.
 - 3. Greenheck.
- B. Provide prefabricated roof curbs to flash and support roof-penetrating pipes/conduits.
- C. Double shell, 2-inch-thick, 2- x 2-inch wood nailer, insulated, braced, pitched, and extended as required with built-in cant strip where required for compatibility with roofing system.
- D. Equipment Pipe/Conduit Curbs:
 - 1. Galvanized-steel construction with continuous wood nailer. Minimum height: 18 inches.
 - 2. Mitered and welded corner seams, integral base plate, and galvanized-steel counter flashing.
 - 3. Compatible with roofing and roofing-insulation type. Coordinate with General Contractor.
- E. Provide thermoplastic curb cap with graduated step neoprene boot and hose clamp for each pipe conduit penetration. Coordinate number and location of all pipe penetrations with Divisions 22, 23, and 26.
- F. Insulation shall be rigid type, R=10 minimum.
- G. Provide rubber gasket on top of curb to make airtight seal.

2.11 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories in accordance with applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.

- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless steel accessories in stainless steel ducts, and aluminum accessories in aluminum ducts.
- C. Where multiple damper sections are necessary to achieve required dimensions, provide reinforcement to fully support damper assembly when fully closed at full system design static pressure.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated and as needed for testing and balancing.
- G. Install firedampers in accordance with UL listing.
- H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. Adjacent to and close enough to fire dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 2. At each change in direction and at maximum 50-ft. spacing.
 - 3. Control devices requiring inspection.
 - 4. Elsewhere as indicated.
- I. Install access doors with swing against duct static pressure.
- J. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches.
 - 2. Two-Hand Access: 12 by 6 inches.
 - 3. Head and Hand Access: 18 by 10 inches.
- K. Install flexible connectors to connect ducts to equipment.
- L. For fans developing static pressures of 5 inches wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- M. Install duct test holes where required for testing and balancing purposes.

3.2 ROOF CURBS FOR EQUIPMENT SUPPORT AND PIPE/CONDUIT FLASHINGS

- A. Install in accordance with manufacturer's recommendations and as called for.
- B. Coordinate with other Divisions for quantity, size, and locations of required openings.

3.3 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect locations of access doors, and verify that size and location of access doors are adequate to perform required operation.

3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation, and verify that vanes do not move or rattle.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION

SECTION 23 33 46

FLEXIBLE DUCTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Insulated flexible ducts.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For flexible ducts.
 - 1. Include plans showing locations and mounting and attachment details on duct Shop Drawings.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- C. Comply with the Air Diffusion Council's "ADC Flexible Air Duct Test Code FD 72-R1."
- D. Comply with ASTM E96/E96M, "Test Methods for Water Vapor Transmission of Materials."

2.2 INSULATED FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Flexmaster U.S.A., Inc.
 - 2. McGill AirFlow LLC.
 - 3. Thermaflex; a Flex-Tek Group company.
 - 4. Ward Industries; a brand of Hart & Cooley, Inc.
- B. Insulated, Flexible Duct: UL 181, Class 1, two-ply vinyl film or aluminum laminate supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor-barrier film.
 - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 - 2. Maximum Air Velocity: 4000 fpm.
 - 3. Temperature Range: Minus 10 to plus 160 deg F.
 - 4. Insulation R-Value: R6.

2.3 FLEXIBLE DUCT CONNECTORS

- A. Non-Clamp Connectors: Adhesive plus sheet metal screws.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install flexible ducts according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.
- B. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- C. Connect diffusers to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place. Maximum one 90 deg bend in flexible duct.
- D. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.
- E. Install duct test holes where required for testing and balancing purposes.
- F. Installation:
 - 1. Install ducts fully extended.
 - 2. Do not bend ducts across sharp corners.
 - 3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
 - 4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
 - 5. Install flexible ducts in a direct line, without sags, twists, or turns.
- G. Supporting Flexible Ducts:
 - 1. Suspend flexible ducts with bands 1-1/2 inches wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch per 12 inches.
 - 2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.
 - 3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
 - 4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches o.c.

END OF SECTION

SECTION 23 37 13

DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Louver face diffusers.
 - 2. Adjustable blade face registers.
 - 3. Fixed face registers.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products by Krueger as indicated in this Section or comparable product by one of the following:
 - 1. Anemostat Products; a Mestek company.
 - 2. Krueger.
 - 3. Price Industries.
 - 4. Titus.
 - 5. Tuttle & Bailey.

2.2 DIFFUSERS

- A. Louver Face Diffusers SA:
 - 1. Basis-of Design Product: Krueger #1450A.
 - 2. Devices shall be specifically designed for variable-air-volume flows.
 - 3. Material: Steel.
 - 4. Finish: Powder-coat finish, white.
 - 5. Face Size: As shown on Drawings.
 - 6. Mounting: As required by ceiling system installed in..
 - 7. Pattern: Adjustable core style.
 - 8. Accessories:
 - a. Adjustable pattern vanes.
 - b. Plaster ring.
 - c. Sectorizing baffles.

2.3 REGISTERS

- A. Adjustable Blade Face Register SB:
 - 1. Basis-of Design Product: Krueger #880OBD.
 - 2. Material: Steel.
 - 3. Finish: Powder-coat finish, white.
 - 4. Face Blade Arrangement: Horizontal spaced 3/4 inch apart.
 - 5. Core Construction: Integral.
 - 6. Rear-Blade Arrangement: Vertical spaced 3/4 inch apart.

7. Frame: 1 inch wide.
8. Mounting: Countersunk screw.
9. Damper Type: Adjustable opposed blade.
10. Accessories:
 - a. Rear-blade gang operator.

2.4 GRILLES

- A. Fixed Face Grille RA & EA:
 1. Basis-of Design Product: Krueger #S80.
 2. Material: Steel.
 3. Finish: Powder-coat finish, white.
 4. Face Arrangement: 3/4" spaced bars.
 5. Frame: 1 inch wide.
 6. Mounting: Countersunk screw.

2.5 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 23 51 23

GAS VENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Listed double-wall vents.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For vents.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Detail fabrication and assembly of hangers and seismic restraints.

1.3 QUALITY ASSURANCE

- A. Certified Sizing Calculations: Manufacturer shall provide and certify venting system sizing calculations.

PART 2 - PRODUCTS

2.1 LISTED SPECIAL GAS VENTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Heat-Fab, Inc.
 - 2. Metal-Fab, Inc.
 - 3. Selkirk Corporation.
- B. Description: Double-wall metal vents tested according to UL 1738 and rated for 480 deg F continuously, with positive or negative flue pressure complying with NFPA 211.
- C. Construction: Inner shell and outer jacket separated by at least a 1/2-inch airspace.
- D. Inner Shell: ASTM A 959, Type 29-4C stainless steel.
- E. Outer Jacket: Aluminized steel.
- F. Accessories: Tees, elbows, increasers, draft-hood connectors, support assemblies, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Listed Special Gas Vent: Condensing gas appliances.

3.2 INSTALLATION OF LISTED VENTS

- A. Comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.
- B. Seal between sections of positive-pressure vents according to manufacturer's written installation instructions, using sealants recommended by manufacturer.
- C. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.
- D. Lap joints in direction of flow.
- E. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

END OF SECTION

SECTION 23 72 23.29

PACKAGED, OUTDOOR, FIXED-PLATE ENERGY-RECOVERY UNITS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fixed-plate, sensible heat exchangers in packaged, outdoor, energy-recovery units.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For packaged, outdoor, fixed-plate, energy-recovery units.
 - 1. Include plans, elevations, sections, details, and mounting details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, lifting requirements, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.
 - 4. Submit wind-force calculations (Fp), curb attachment details, and wind restraints.
 - a. Calculations and selections shall be stamped and signed by a Professional Engineer.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.4 COORDINATION

- A. Coordinate sizes and locations of building openings and duct connections with actual equipment provided.

1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of packaged, outdoor, fixed-plate, energy-recovery units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Packaged Energy-Recovery Units: One year from date of Substantial Completion.
 - 2. Warranty Period for Fixed-Plate Heat Exchangers: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
- B. ASHRAE Compliance:
 - 1. Applicable requirements in ASHRAE 62.1.
 - 2. Capacity ratings for fixed-plate energy-recovery units shall comply with ASHRAE 84.

- C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1.
- D. UL Compliance:
 - 1. Packaged heat-recovery ventilators shall comply with requirements in UL 1815 or UL 1812.
 - 2. Electric coils shall comply with requirements in UL 1995.

2.2 CAPACITIES AND CHARACTERISTICS

- A. Capacities as scheduled on Drawings.
- B. Type: Fixed-plate sensible heat, energy-recovery unit.
- C. Filters:
 - 1. Type: Cleanable wire mesh and pleated.
 - 2. Minimum Efficiency Reporting Value:
 - a. MERV Rating: MERV 13 in accordance with ASHRAE 52.2.

2.3 PACKAGED, OUTDOOR, FIXED-PLATE, SENSIBLE HEAT, ENERGY-RECOVERY UNITS

- 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. Greenheck Fan Corporation.
 - 2. Lifebreath; a division of Airia Brands.
 - 3. Venmar CES Inc.
 - 4. RenewAire.
- B. Source Limitations: Obtain packaged, outdoor, fixed-plate, energy-recovery units from single manufacturer.
- C. Surfaces in Contact with Airstream: Comply with requirements in ASHRAE 62.1.
- D. Housing: Manufacturer's standard construction with corrosion-protection coating and exterior finish, gasketed, hinged access doors, or removable panels with neoprene gaskets for inspection and access to internal parts, minimum 2-inch thick, R=10 thermal insulation, knockouts for electrical and piping connections, exterior drain connection, and lifting lugs.
- E. Fixed-Plate, Sensible Heat Exchanger:
 - 1. Casing: Aluminum.
 - 2. Drain Pan: Same material as casing, with drain connections on exhaust and supply side.
 - a. Comply with requirements in ASHRAE 62.1.
 - 3. Plates: Evenly spaced, sealed, and arranged for counter- or cross-flow.
 - a. Plate Material: Embossed aluminum.
 - b. 50 percent minimum efficiency in accordance with NYS IECC, C403.2.7.
 - 4. Bypass Plenum: Within casing, with gasketed face-and-bypass dampers having operating rods extended outside casing.
- F. Supply and Exhaust Fans: Forward-curved centrifugal fan with spring isolators or fan wall technology.
 - 1. Motors and Drives: Direct driven or belt driven, with adjustable sheaves.
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors.
 - b. Motor Sizes: Minimum size as indicated. If size is not indicated, provide motor large enough so driven load will not require motor to operate in service factor range above 1.0.

- G. Filters:
 1. Description: Cleanable wire mesh at outside air intake and pleated factory-fabricated, self-supported, disposable air filters with holding frames.
 2. UL Compliance: Comply with UL 900.
 3. Media: Interlaced glass fibers sprayed with nonflammable adhesive.
 4. Filter Media Frame: Beverage board with perforated metal retainer or metal grid on outlet side.
 5. Filter-Mounting Frames: Arranged with access doors or panels on both sides of unit. Filters shall be removable from one side or lift out from access plenum.
- H. Wiring: Fabricate units with space within housing for electrical conduits. Wire motors and controls so only external connections are required during installation.
 1. Outdoor Enclosure: NEMA 250, Type 3R enclosure contains relays, starters, and terminal strip.
 2. Include fused disconnect switches.

2.4 CONTROLS

- A. Starting relay, factory mounted and wired, and manual motor starter for field wiring.
- B. Economizer Control: Fixed-plate airflow bypass. See Section 23 09 23 "Direct Digital Control (DDC) System for HVAC" for control sequence.
- C. Low-Voltage Transformer: Integral transformer to provide control voltage to unit from primary incoming electrical service.
- D.

2.5 SOURCE QUALITY CONTROL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by NRTL, and marked for intended location and application.
- B. AHRI Compliance: Capacity ratings for air-to-air energy-recovery equipment certified as complying with AHRI 1060 (IP).
- C. Fan Performance Rating: Comply with AMCA 211, and label fans with AMCA-certified rating seal. Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency in accordance with AMCA 210 and ASHRAE 51.
- D. Fan Sound Ratings: Comply with AMCA 301 or AHRI 260 (IP).
- E. UL Compliance:
 1. Packaged, Fixed-Plate, Energy-Recovery Units: Comply with requirements in UL 1812.
 2. Electric Coils: Comply with UL 1995.

PART 3 - EXECUTION

3.1 INSTALLATION OF PACKAGED, OUTDOOR, FIXED-PLATE, ENERGY-RECOVERY UNITS

- A. Examine casing insulation materials and filter media before packaged, outdoor, fixed-plate, energy-recovery unit installation. Replace insulation materials and filter media that are wet, moisture damaged, or mold damaged.
- B. Equipment Mounting:
 1. Install roof-mounted packaged, outdoor, fixed-plate, energy-recovery units on manufacturer's-recommended-height equipment roof curbs.

- C. Install units with clearances for service and maintenance.
- D. Do not operate equipment fans until temporary or permanent filters are in place. Replace temporary filters used during construction and testing with new, clean filters prior to final inspection.

3.2 DUCTWORK CONNECTIONS

- A. Comply with requirements for ductwork in accordance with Section 23 31 13 "Metal Ducts."

3.3 ELECTRICAL CONNECTIONS

- A. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

3.4 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections with assistance of factory-authorized service representative.
- B. Tests and Inspections:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Packaged, outdoor, fixed-plate, energy-recovery units will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.6 DEMONSTRATION

- A. Engage factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-to-air energy-recovery units.

END OF SECTION

SECTION 23 74 16.11

PACKAGED, SMALL-CAPACITY, ROOFTOP AIR-CONDITIONING UNITS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes packaged, small-capacity, rooftop air-conditioning units (RTUs) with the following components:
 - 1. Casings.
 - 2. Fans, drives, and motors.
 - 3. Coils.
 - 4. Refrigerant circuit components.
 - 5. Air filtration.
 - 6. Gas furnaces.
 - 7. Dampers.
 - 8. Electrical power connections.
 - 9. Controls.
 - 10. Roof curbs.
 - 11. Accessories.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of RTU.
- B. Shop Drawings: For each packaged, small-capacity, rooftop air-conditioning unit.
 - 1. Include plans, elevations, sections, and mounting and attachment details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.
 - 4. Submit wind-force calculations (Fp), curb attachment details, and wind restraints.
 - a. Calculations and selections shall be stamped and signed by a Professional Engineer.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: Submit certification that specified equipment will withstand wind forces identified in "Performance Requirements" Article.
- B. System startup reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

1.5 WARRANTY

- A. Warranty: Manufacturer agrees to repair or replace components of packaged, small-capacity, rooftop air-conditioning units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: one year from date of Substantial Completion.
 - 2. Warranty Period for Heat Exchangers: Manufacturer's standard, but not less than five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of RTUs and components.
- C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- E. UL Compliance: Comply with UL 1995.

2.2 CAPACITIES AND CHARACTERISTICS

- A. Capacities: As scheduled on Drawings.
- B. Dampers:
 - 1. Outdoor- and Return-Air Mixing Dampers: Opposed-blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced cabinet. Connect operating rods with common linkage or gears and interconnect so dampers operate simultaneously.
 - 2. Powered relief fan with damper.
- C. Recirculating-Air Filters:
 - 1. Minimum Efficiency Reporting Value:
 - a. MERV Rating: MERV 13, according to ASHRAE 52.2.

2.3 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carrier Global Corporation.
 - 2. Lennox Industries, Inc.; Lennox International.
 - 3. Trane.
 - 4. YORK; brand of Johnson Controls International plc, Building Solutions North America.

2.4 UNIT CASINGS

- A. General Fabrication Requirements for Casings: Formed and reinforced single-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
- B. Single-Wall Construction:
 - 1. Outside Casing Wall: Galvanized steel, minimum 18-gauge thick with manufacturer's standard finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
 - 2. Casing Insulation:
 - a. Materials: Fiberglass with erosion coating.
 - b. Casing Panel R-Value: Minimum R=13.
 - c. Insulation Thickness: 2 inches.

- d. Thermal Break: Provide continuity of insulation with no through-casing metal in casing walls, floors, or roof of unit.
- C. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.
- D. Static-Pressure Classifications:
 - 1. For Unit Sections Upstream of Fans: Minus 2-inch wg.
 - 2. For Unit Sections Downstream and Including Fans: 2-inch wg.
- E. Panels and Doors:
 - 1. Panels:
 - a. Fabrication: Formed and reinforced with same materials and insulation thickness as casing.
 - b. Fasteners: Two or more camlock type for panel lift-out operation. Arrangement shall allow panels to be opened against air-pressure differential.
 - c. Gasket: Neoprene, applied around entire perimeters of panel frames.
 - d. Size: Large enough to allow inspection and maintenance of air-handling unit's internal components.
 - 2. Access Doors:
 - a. Hinges: A minimum of two ball-bearing hinges or stainless-steel piano hinge and two wedge-lever-type latches, operable from inside and outside. Arrange doors to be opened against air-pressure differential.
 - b. Gasket: Neoprene, applied around entire perimeters of panel frames.
 - c. Size: Large enough to allow inspection and maintenance of air-handling unit's internal components.
 - 3. Locations and Applications:
 - a. All Unit Sections: Doors or access panels.
- F. Condensate Drain Pans:
 - 1. Location: Each type of cooling coil.
 - 2. Construction:
 - a. Single-wall, galvanized-steel or noncorrosive polymer or stainless steel sheet.
 - 3. Drain Connection:
 - a. Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple.
 - 4. Slope: Minimum 0.125-in./ft. slope, to comply with ASHRAE 62.1, in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and from humidifiers and to direct water toward drain connection.
 - 5. Width: Entire width of water producing device.
 - 6. Depth: A minimum of 2 inches deep.
 - 7. Pan-Top Surface Coating for Galvanized-Steel Drain Pans: Asphaltic waterproofing compound.
 - 8. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

2.5 FANS, DRIVES, AND MOTORS

- A. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.
- B. Supply-Air Fans: Centrifugal, rated according to AMCA 210; galvanized or painted steel; mounted on solid-steel shaft.
 - 1. Shafts: With field-adjustable alignment.
 - a. Turned, ground, and polished hot-rolled steel with keyway.
 - 2. Shaft Bearings:

- a. Heavy-duty, self-aligning, pillow-block type with an L-50 rated life of minimum 100,000 hours according to ABMA 9.
 - 3. Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.
 - a. Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.
 - 4. Centrifugal Fan Wheels: Inlet flange, backplate, and shallow blades with inlet and tip curved forward in direction of airflow and mechanically fastened to flange and backplate; steel or aluminum hub swaged to backplate and fastened to shaft with setscrews.
 - 5. Mounting: For internal vibration isolation. Factory-mount fans with manufacturer's standard vibration isolation mounting devices having a minimum static deflection of 1 inch.
 - 6. Flexible Connector: Factory fabricated with a fabric strip minimum 3-1/2 inches wide, attached to two strips of minimum 2-3/4-inch-wide by 0.028-inch-thick, galvanized-steel sheet.
 - a. Flexible Connector Fabric: Glass fabric, double coated with neoprene. Fabrics, coatings, and adhesives shall comply with UL 181, Class 1.
- C. Drives, Direct: Factory-mounted, direct drive.
- D. Condenser-Coil Fan: Variable-speed propeller, mounted on shaft of permanently lubricated ECM motors.
- E. Relief-Air Fan: Propeller, forward curved, or backward inclined, shaft mounted on permanently lubricated motor.
- F. Motors:
 - 1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors.
 - 2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 3. Enclosure Type: Open, drip-proof.
 - 4. Efficiency: Premium efficient as defined in NEMA MG 1 and IECC 2015.
 - 5. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

2.6 COILS

- A. General Requirements for Coils:
 - 1. Comply with AHRI 410.
 - 2. Fabricate coils section to allow for removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
 - 3. Coils shall not act as structural component of unit.
- B. Supply-Air Refrigerant Coil:
 - 1. Tubes: Copper.
 - 2. Fins:
 - a. Material: Aluminum.
 - 3. Fin and Tube Joints: Mechanical bond.
 - 4. Headers: Seamless-copper headers with brazed connections.
 - 5. Frames: Galvanized steel.
 - 6. Ratings: Designed, tested, and rated according to ASHRAE 33 and AHRI 410.
 - a. Working Pressure: Minimum 300 psig.

2.7 REFRIGERANT CIRCUIT COMPONENTS

- A. Compressor: Hermetic, scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.
- B. Refrigeration Specialties:
 - 1. Refrigerant: R-410A.
 - 2. Expansion valve with replaceable thermostatic element.
 - 3. Refrigerant filter/dryer.
 - 4. Manual-reset high-pressure safety switch.
 - 5. Automatic-reset low-pressure safety switch.
 - 6. Minimum off-time relay.
 - 7. Automatic-reset compressor motor thermal overload.
 - 8. Brass service valves installed in compressor suction and liquid lines.
 - 9. Four-way reversing valve with a replaceable magnetic coil, thermostatic expansion valves with bypass check valves, and a suction line accumulator.

2.8 AIR FILTRATION

- A. Panel Filters:
 - 1. Description: Pleated factory-fabricated, self-supported, disposable air filters with holding frames.
 - 2. Filter Unit Class: UL 900.
 - 3. Media: Interlaced glass, synthetic or cotton fibers.
 - 4. Filter-Media Frame: Beverage board with perforated metal retainer, or metal grid, on outlet side.

2.9 GAS FURNACES

- A. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47/CSA 2.3 and NFPA 54.
- B. CSA Approval: Designed and certified by and bearing label of CSA.
- C. Burners: Aluminized steel.
 - 1. Rated Minimum Turndown Ratio: 30 to 1.
 - 2. Fuel: Natural gas.
 - 3. Ignition: Electronically controlled electric spark or hot-surface igniter with flame sensor.
 - 4. Gas Control Valve: Modulating.
 - 5. Gas Train: Single-body, regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.
- D. Heat-Exchanger and Drain Pan: Stainless steel.
- E. Venting, Power: Power vented, with integral, motorized centrifugal fan interlocked with gas valve with vertical extension.
- F. Safety Controls:
 - 1. Gas Manifold: Safety switches and controls complying with ANSI standards.

2.10 DAMPERS

- A. Outdoor- and Return-Air Dampers: Low-leakage, double-skin, airfoil-blade, galvanized-steel dampers with compressible jamb seals and extruded-vinyl blade edge seals in opposed-blade arrangement with zinc-plated steel operating rods rotating in sintered bronze or nylon bearings mounted in a single galvanized-steel frame, and with operating

rods connected with a common linkage. Leakage rate shall not exceed 4 cfm/sq. ft. at 1-inch wg and 8 cfm/sq. ft. at 4-inch wg.

- B. Electronic Damper Operators:
1. Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
 2. Electronic damper position indicator shall have visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
 3. Operator Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements.
 - b. Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
 - c. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
 4. Non-Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 5. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.
 6. Size dampers for running torque calculated as follows:
 - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
 - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
 - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. of damper.
 - d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
 - e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
 - f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.
 7. Coupling: V-bolt and V-shaped, toothed cradle.
 8. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
 9. Fail-Safe Operation: Mechanical, spring-return mechanism with external, manual gear release on non-spring-return actuators.
 10. Power Requirements (Two-Position Spring Return): 24 V dc.
 11. Power Requirements (Modulating): Maximum 10 VA at 24 V ac or 8 W at 24 V dc.
 12. Proportional Signal: 2 to 10 V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
 13. Temperature Rating: Minus 22 to plus 122 deg F.

2.11 ELECTRICAL POWER CONNECTIONS

- A. RTU shall have a single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

2.12 CONTROLS

- A. Control equipment and sequence of operation are specified in Section 23 09 23 "Direct Digital Control (DDC) System for HVAC."
- B. DDC Controller:
1. Controller shall have volatile-memory backup.
 2. Safety Control Operation:
 - a. Firestats: Stop fan and close outdoor-air damper if air greater than 130 deg F enters unit. Provide additional contacts for alarm interface to fire-alarm control panel.

- b. Low-Discharge Temperature: Stop fan and close outdoor-air damper if supply-air temperature is less than 40 deg F.
 - c. Defrost Control for Condenser Coil: Pressure differential switch to initiate defrost sequence.
 - 3. Economizer Outdoor-Air Damper Operation:
 - a. Occupied Periods: Open to occupied ventilation CFM as scheduled. Controller shall permit air-side economizer operation when outdoor air is less than 60 deg F. Use mixed-air and outdoor-air temperature to adjust mixing dampers. Start relief-air fan with end switch on outdoor-air damper. During economizer cycle operation, lock out cooling. Provide NYS-code-required economizer fault detection and alarm.
 - b. Unoccupied Periods: Close outdoor-air damper and open return-air damper.
 - 4. Terminal-Unit Relays:
- C. Interface Requirements for HVAC Instrumentation and Control System:
 - 1. Interface relay for scheduled operation.
 - 2. Interface relay to provide indication of fault at the central workstation and diagnostic code storage.
 - 3. Provide BACnet compatible interface for central HVAC control workstation for the following:
 - a. Adjusting set points.
 - b. Monitoring supply fan start, stop, and operation.
 - c. Inquiring data to include outdoor-air damper position, supply- and room-air temperature.
 - d. Monitoring occupied and unoccupied operations.
 - e. Monitoring constant and variable motor loads.
 - f. Monitoring variable-frequency drive operation.
 - g. Monitoring cooling load.
 - h. Monitoring economizer cycles.
 - i. Monitoring air-distribution static pressure and ventilation air volume.

2.13 ROOF CURBS

- A. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.
 - 1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
 - a. Materials: ASTM C1071, Type I or II.
 - b. Thickness: 2 inches.
 - 2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
 - a. Liner Adhesive: Comply with ASTM C916, Type I.
 - b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
 - c. Liner materials applied in this location shall have airstream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
 - d. Liner Adhesive: Comply with ASTM C916, Type I.
- B. Curb Dimensions: Height of 24 inches.

2.14 ACCESSORIES

- A. Safeties:
 - 1. High-pressure control.
 - 2. Gas furnace airflow-proving switch.

- B. Coil guards of painted, galvanized-steel wire.
- C. Outdoor-air intake weather hood with moisture eliminator.
- D. Oil separator.

2.15 SOURCE QUALITY CONTROL

- A. AHRI Compliance:
 - 1. Comply with AHRI 210/240 for testing and rating energy efficiencies for RTUs.
 - 2. Comply with AHRI 340/360 for testing and rating energy efficiencies for RTUs.
 - 3. Comply with AHRI 270 for testing and rating sound performance for RTUs.
 - 4. Comply with AHRI 1060 for testing and rating performance for air-to-air exchanger.
- B. AMCA Compliance:
 - 1. Comply with AMCA 11 and bear the AMCA-Certified Ratings Seal for air and sound performance according to AMCA 211 and AMCA 311.
 - 2. Damper leakage tested according to AMCA 500-D.
 - 3. Operating Limits: Classify according to AMCA 99.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.
- B. Roof Curb: Install on roof structure, level and secure, according to NRCA's "NRCA Roofing Manual: Membrane Roof Systems." or AHRI Guideline B. Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction. Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts. Coordinate sizes and locations of roof curbs with actual equipment provided.
- C. Unit Support: Install unit level on structural curbs. Coordinate wall penetrations and flashing with wall construction. Secure RTUs to structural support with anchor bolts.

3.2 PIPING CONNECTIONS

- A. Provide deep trap at connection to drain pan. Pipe to roof and install cleanouts at changes in direction.
- B. Gas Piping: Connect gas piping from valved outlet left by Division 22 to burner, full size of supply gas piping, and connect with ground joint union with sufficient clearance for burner removal and service.

3.3 DUCT CONNECTIONS

- A. Comply with duct installation requirements specified in other HVAC Sections. Drawings indicate general arrangement of ducts. The following are specific connection requirements:
 - 1. Install ducts to termination at top of roof curb.
 - 2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
 - 3. Install return-air duct continuously through roof structure.

3.4 ELECTRICAL CONNECTIONS

- A. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

3.5 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Tests and Inspections:
 - 1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
 - 2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. RTU will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs.

END OF SECTION

SECTION 23 81 29

VARIABLE-REFRIGERANT-FLOW HVAC SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes complete VRF HVAC system(s) including, but not limited to the following components to make a complete operating system(s) according to requirements indicated:
1. Indoor, concealed, ceiling-mounted units for ducting.
 2. Indoor, recessed, ceiling-mounted units.
 3. System controls.
 4. System refrigerant and oil.
 5. System condensate-drain piping.
 6. System hydronic piping.
 7. System refrigerant piping.
 8. Metal hangers and supports.
 9. Metal framing systems.
 10. Fastener systems.
 11. Equipment stands.
 12. Piping and tubing insulation.
 13. System control cable and raceways.

1.2 DEFINITIONS

- A. Heat Recovery System Operation: System capable of operation with simultaneous heating and cooling zones that transfer heat between zones.
- B. HRCU: Heat Recovery Control Unit. HRCUs are used in heat recovery VRF HVAC systems to manage and control refrigerant between indoor units to provide simultaneous heating and cooling zones. "Heat Recovery Control Unit" is the term used by ASHRAE for what different manufacturers term as branch circuit controller, branch selector box, changeover box, flow selector unit, mode change unit, and other such terms.
- C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- D. Plenum: A space forming part of the air distribution system to which one or more air ducts are connected. An air duct is a passageway, other than a plenum, for transporting air to or from heating, ventilating, or air-conditioning equipment.
- E. Two-Pipe System Design: One refrigerant vapor line and one refrigerant liquid line connect a single outdoor unit or multiple manifold outdoor units in a single system to associated system HRCUs. One refrigerant liquid line and refrigerant vapor line connect HRCUs to associated indoor units. HRCUs used in two pipe systems act as an intermediate heat exchanger and include diverting valves and gas/liquid separators to move high and low pressure refrigerant between indoor units.
- F. VRF: Variable refrigerant flow.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for indoor and outdoor units and for HRCUs.

2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 3. Include operating performance at design conditions and at extreme maximum and minimum outdoor ambient conditions.
 4. Include description of system controllers, dimensions, features, control interfaces and connections, power requirements, and connections.
 5. Include system operating sequence of operation in narrative form for each unique indoor- and outdoor-unit and HRCU control.
 6. Include description of control software features.
 7. Include total refrigerant required and a comprehensive breakdown of refrigerant required by each system installed.
 8. Include refrigerant type and data sheets showing compliance with requirements indicated.
 9. For system design software.
 10. Indicate location and type of service access.
- B. Shop Drawings: For VRF HVAC systems.
1. Include plans, elevations, sections, mounting, and attachment details.
 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 3. Include diagrams and details of refrigerant piping and tubing showing installation requirements for manufacturer-furnished divided flow fittings.
 4. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
1. For Installer: Certificate from VRF HVAC system manufacturer certifying that Installer has successfully completed prerequisite training administered by manufacturer for proper installation of systems, including but not limited to, equipment, piping, controls, and accessories indicated and furnished for installation.
 - a. Retain copies of Installer certificates on-site and make available on request.
 2. For VRF HVAC system manufacturer.
 3. For VRF HVAC system provider.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For VRF HVAC systems to include in emergency, operation, and maintenance manuals.
- B. Software and Firmware Operational Documentation:
1. Software operating and upgrade manuals.
 2. Program Software Backup: On CD or DVD, USB media, or approved cloud storage platform, complete with data files.
 3. Device address list.
 4. Printout of software application and graphic screens.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in a clean and dry place.
- B. Comply with manufacturer's written rigging and installation instructions for unloading and moving to final installed location.
- C. Handle products carefully to prevent damage, breaking, denting, and scoring. Do not install damaged products.

- D. Protect products from weather, dirt, dust, water, construction debris, and physical damage.
 - 1. Retain factory-applied coverings on equipment to protect finishes during construction and remove just prior to operating unit.
 - 2. Cover unit openings before installation to prevent dirt and dust from entering inside of units. If required to remove coverings during unit installation, reapply coverings over openings after unit installation and remove just prior to operating unit.
- E. Replace installed products damaged during construction.

1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace equipment and components that fail(s) in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Faulty operation.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - 2. Warranty Period:
 - a. For Compressor: Five years from date of Substantial Completion.
 - b. For Parts, Including Controls: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Mitsubishi Electric & Electronics USA, Inc.
 - 2. Panasonic Corporation of North America.
 - 3. Lennox.
 - 4. Samsung HVAC.
 - 5. Trane Company (The).
- B. Source Limitations: Obtain products from single source from single manufacturer including, but not limited to, the following:
 - 1. Indoor and outdoor units, including accessories.
 - 2. Controls and software.
 - 3. HRCUs.
 - 4. Refrigerant isolation valves.
 - 5. Specialty refrigerant pipe fittings.

2.2 SYSTEM DESCRIPTION

- A. Direct-expansion (DX) VRF HVAC system(s) with variable capacity in response to varying cooling and heating loads. System shall consist of multiple indoor units, HRCUs, outdoor unit(s), piping, controls, and electrical power to make complete operating system(s) complying with requirements indicated.
 - 1. Two-pipe system design.
 - 2. System(s) operation, heat recovery as indicated on Drawings.
 - 3. Each system with one refrigerant circuit shared by all indoor units connected to system.
- 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. AHRI Compliance: System and equipment performance certified according to AHRI 1230 and products listed in AHRI directory.
- D. ASHRAE Compliance:
 1. ASHRAE 15: For safety code for mechanical refrigeration.
 2. ASHRAE 62.1: For indoor air quality.
 3. ASHRAE 135: For control network protocol with remote communication.
 4. ASHRAE/IES 90.1 Compliance: For system and component energy efficiency.
- E. UL Compliance: Comply with UL 1995.

2.3 PERFORMANCE REQUIREMENTS

- A. Service Access:
 1. Provide and document service access requirements.
 2. Locate equipment, system isolation valves, and other system components that require service and inspection in easily accessible locations. Avoid locations that are difficult to access if possible.
 3. Where serviceable components are installed behind walls and above inaccessible ceilings, provide finished assembly with access doors or panels to gain access. Properly size the openings to allow for service, removal, and replacement.
 4. If less than full and unrestricted access is provided, locate components within an 18-inch reach of the finished assembly.
 5. Where ladder access is required to service elevated components, provide an installation that provides for sufficient access within ladder manufacturer's written instructions for use.
 6. Comply with OSHA regulations.
- B. System Installation Requirements:
 1. Install systems indicated according to manufacturer's recommendations and written instructions.
 2. Where manufacturer's requirements differ from requirements indicated, contact Architect for direction. The most stringent requirements should apply unless otherwise directed in writing by Architect.
- C. System Adaptability to Future Changes: Arrange and size system refrigerant piping to accommodate future changes to system without having to resize and replace existing refrigerant piping.
 1. Each branch circuit shall accommodate addition of two indoor unit(s) with unit capacity equal to largest indoor unit connected to the branch circuit.
- D. Isolation of Equipment: Provide isolation valves to isolate each HRCU, indoor unit and outdoor unit for service, removal, and replacement without interrupting system operation.
- E. System Capacity Ratio: The sum of connected capacity of all indoor units shall be within the following range of outdoor-unit rated capacity:
 1. Not less than 50 percent.
 2. Not more than 130 percent.
 3. Range acceptable to manufacturer.
- F. System Turndown: Stable operation down to 20 percent of outdoor-unit capacity.
- G. System Auto Refrigerant Charge: Each system shall have an automatic refrigerant charge function to ensure the proper amount of refrigerant is installed in system.
- H. Outdoor Conditions:
 1. Suitable for outdoor ambient conditions encountered.

- a. Design equipment and supports to withstand wind loads of governing code.
- 2. Maximum System Operating Outdoor Temperature: See Drawings.
- 3. Minimum System Operating Outdoor Temperature: See Drawings.
- I. Sound Performance: Sound levels generated by operating HVAC equipment shall be within requirements indicated.
 - 1. Indoor: Within design guidelines of "2015 ASHRAE HANDBOOK- HVAC Applications."
 - 2. Outdoor: Within ordinance of governing authorities.
- J. Thermal Movements: Allow for controlled thermal movements from ambient, surface, and system temperature changes.
- K. Capacities and Characteristics: As indicated on Drawings.

2.4 INDOOR, CONCEALED, CEILING-MOUNTED UNITS FOR DUCTING

- A. Description: Factory-assembled complete unit with components, piping, wiring, and controls required for mating to ductwork, piping, power, and controls field connections.
- B. Cabinet:
 - 1. Material: Galvanized or painted steel.
 - 2. Insulation: Manufacturer's standard internal insulation, complying with ASHRAE 62.1, to provide thermal resistance and prevent condensation.
 - 3. Duct Connections: Extended collar or flange, or designated exterior cabinet surface, designed for attaching field-installed ductwork.
 - 4. Mounting: Manufacturer-designed provisions for field installation.
 - 5. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.
- C. DX Coil Assembly:
 - 1. Coil Casing: Aluminum, galvanized, or stainless steel.
 - 2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
 - 3. Coil Tubes: Copper, of diameter and thickness required by performance.
 - 4. Expansion Valve: Electronic modulating type with linear or proportional characteristics.
 - 5. Unit Internal Tubing: Copper tubing with brazed joints.
 - 6. Unit Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
 - 7. Field Piping Connections: Manufacturer's standard.
 - 8. Factory Charge: Dehydrated air or nitrogen.
 - 9. Testing: Factory pressure tested and verified to be without leaks.
- D. Drain Assembly:
 - 1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
 - 2. Condensate Removal: Unit-mounted pump or other integral lifting mechanism, capable of lifting drain water to an elevation above top of cabinet.
 - 3. Field Piping Connection: Non-ferrous material with threaded NPT or barbed hose fitting.
- E. Fan and Motor Assembly:
 - 1. Fan(s):
 - a. Direct-drive arrangement.
 - b. Single or multiple fans connected to a common motor shaft and driven by a single motor.

- c. Fabricated from non-ferrous components or ferrous components with corrosion-resistant finish.
 - d. Wheels statically and dynamically balanced.
 - 2. Motor: Brushless dc or electronically commutated with permanently lubricated bearings.
 - 3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
 - 4. Speed Settings and Control: Two (low, high), three (low, medium, high), or more than three speed settings or variable speed with a speed range of least 50 percent.
 - 5. Vibration Control: Integral isolation to dampen vibration transmission.
- F. Filter Assembly:
 - 1. Access: Bottom, side, or rear to accommodate field installation without removing ductwork and to accommodate filter replacement without need for tools.
 - 2. Efficiency: ASHRAE 52.2, MERV 13.
 - 3. Media:
 - a. Replaceable: Extended surface, panel, or cartridge with antimicrobial treatment fiber media.
- G. Unit Controls:
 - 1. Enclosure: Metal, suitable for indoor locations.
 - 2. Factory-Installed Controller: Configurable digital control.
 - 3. Factory-Installed Sensors:
 - a. Unit inlet air temperature.
 - b. Coil entering refrigerant temperature.
 - c. Coil leaving refrigerant temperature.
 - 4. Features and Functions:
 - a. Self-diagnostics.
 - b. Time delay.
 - c. Auto-restart.
 - d. External static pressure control.
 - e. Auto operation mode.
 - f. Manual operation mode.
 - g. Filter service notification.
 - h. Power consumption display.
 - i. Drain assembly high water level safety shutdown and notification.
 - j. Run test switch.
 - 5. Communication: Network communication with other indoor and outdoor units.
 - 6. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
 - 7. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
- H. Unit Electrical:
 - 1. Enclosure: Metal, suitable for indoor locations.
 - 2. Field Connection: Single point connection to power unit and integral controls.
 - 3. Disconnecting Means: Factory-mounted circuit breaker or switch.
 - 4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
 - 5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
 - 6. Raceways: Enclose line voltage wiring in raceways.

2.5 INDOOR, RECESSED, CEILING-MOUNTED UNITS

- A. Description: Factory-assembled complete unit with components, piping, wiring, and controls required for mating to ductwork, piping, power, and controls field connections.

- B. Cabinet:
1. Material: Painted steel, or coated steel frame covered by a plastic cabinet, with an architectural acceptable finish suitable for tenant occupancy on exposed surfaces.
 2. Insulation: Manufacturer's standard internal insulation, complying with ASHRAE 62.1, to provide thermal resistance and prevent condensation.
 3. Mounting: Manufacturer-designed provisions for field installation.
 4. Internal Access: Removable panels of adequate size for field access to internal components for inspection, cleaning, service, and replacement.
- C. DX Coil Assembly:
1. Coil Casing: Aluminum, galvanized, or stainless steel.
 2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
 3. Coil Tubes: Copper, of diameter and thickness required by performance.
 4. Expansion Valve: Electronic modulating type with linear or proportional characteristics.
 5. Internal Tubing: Copper tubing with brazed joints.
 6. Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
 7. Field Piping Connections: Manufacturer's standard.
 8. Factory Charge: Dehydrated air or nitrogen.
 9. Testing: Factory pressure tested and verified to be without leaks.
- D. Drain Assembly:
1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
 2. Condensate Removal: Unit-mounted pump or other integral lifting mechanism, capable of lifting drain water to an elevation above top of cabinet.
 3. Field Piping Connection: Non-ferrous material with threaded NPT or barbed hose fitting.
- E. Fan and Motor Assembly:
1. Fan(s):
 - a. Direct-drive arrangement.
 - b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
 - c. Fabricated from non-ferrous components or ferrous components with corrosion protection finish.
 - d. Wheels statically and dynamically balanced.
 2. Motor: Brushless dc or electronically commutated with permanently lubricated bearings.
 3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
 4. Speed Settings and Control: Two (low, high), three (low, medium, high), or more than three speed settings or variable speed with a speed range of least 50 percent.
 5. Vibration Control: Integral isolation to dampen vibration transmission.
- F. Filter Assembly:
1. Access: Bottom, to accommodate filter replacement without the need for tools.
 2. Efficiency: ASHRAE 52.2, MERV 13.
 3. Media:
 - a. Washable: Manufacturer's standard filter with antimicrobial treatment.
- G. Discharge-Air Grille Assembly: Mounted in bottom of unit cabinet.
1. Discharge Pattern: One-, two-, three-, or four-way throw.
 - a. Discharge Pattern Adjustment: Field-adjustable limits for up and down range of motion.

- b. Discharge Pattern Closure: Ability to close individual discharges of units with multiple patterns.
 - 2. Motorized Vanes: Modulating up and down flow pattern for uniform room air distribution.
 - 3. Additional Branch Supply Duct Connection: Sheet metal knockout for optional connection to one additional supply branch duct.
- H. Return-Air Grille Assembly: Manufacturer's standard grille mounted in bottom of unit cabinet.
- I. Outdoor Air Ventilation Connection: Sheet metal knockout for optional connection to outdoor air ventilation duct.
- J. Unit Accessories:
- K. Unit Controls:
 - 1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
 - 2. Factory-Installed Controller: Configurable digital control.
 - 3. Features and Functions: Self-diagnostics, time delay, auto-restart, external static pressure control, filter service notification, drain assembly high water level safety shutdown and notification.
 - 4. Communication: Network communication with other indoor units and outdoor unit(s).
 - 5. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
 - 6. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
- L. Unit Electrical:
 - 1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
 - 2. Field Connection: Single point connection to power entire unit and integral controls.
 - 3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
 - 4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
 - 5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
 - 6. Raceways: Enclose line voltage wiring in raceways to comply with NFPA 70.

2.6 OUTDOOR, AIR-SOURCE HEAT RECOVERY UNITS

- A. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.
 - 1. Specially designed for use in systems with simultaneous heating and cooling.
 - 2. Systems shall consist of one unit, or multiple unit modules that are designed by variable refrigerant system manufacturer for field interconnection to make a single refrigeration circuit that connects multiple indoor units.
 - 3. All units installed shall be from the same product development generation.
- B. Cabinet:
 - 1. Galvanized steel and coated with a corrosion-resistant finish.
 - 2. Mounting: Manufacturer-designed provisions for field installation.
 - 3. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

- C. Compressor and Motor Assembly:
1. One or more positive-displacement, direct-drive and hermetically sealed scroll compressor(s) with inverter drive and turndown to 15 percent of rated capacity.
 2. Protection: Integral protection against the following:
 - a. High refrigerant pressure.
 - b. Low oil level.
 - c. High oil temperature.
 - d. Thermal and overload.
 - e. Voltage fluctuations.
 - f. Phase failure and phase reversal.
 - g. Short cycling.
 3. Speed Control: Variable to automatically maintain refrigerant suction and condensing pressures while varying refrigerant flow to satisfy system cooling and heating loads.
 4. Vibration Control: Integral isolation to dampen vibration transmission.
 5. Oil management system to ensure safe and proper lubrication over entire operating range.
 6. Crankcase heaters with integral control to maintain safe operating temperature.
 7. Fusible plug.
- D. Condenser Coil Assembly:
1. Plate Fin Coils:
 - a. Casing: Aluminum, galvanized, or stainless steel.
 - b. Fins: Aluminum or copper, mechanically bonded to tubes, with arrangement required by performance.
 - c. Tubes: Copper, of diameter and thickness required by performance.
 2. Aluminum Microchannel Coils:
 - a. Series of flat tubes containing a series of multiple, parallel-flow microchannels layered between refrigerant header manifolds.
 - b. Single- or multiple-pass arrangement.
 - c. Construct fins, tubes, and header manifolds of aluminum alloy.
 3. Coating: None.
 4. Hail Protection: Provide condenser coils with louvers, baffles, or hoods to protect against hail damage.
- E. Condenser Fan and Motor Assembly:
1. Fan(s): Propeller type.
 - a. Direct-drive arrangement.
 - b. Fabricated from non-ferrous components or ferrous components with corrosion protection finish to match performance indicated for condenser coil.
 - c. Statically and dynamically balanced.
 2. Fan Guards: Removable safety guards complying with OSHA regulations. If using metal materials, coat with corrosion-resistant coating to match performance indicated for condenser coil.
 3. Motor(s): Brushless dc or electronically commutated with permanently lubricated bearings and rated for outdoor duty.
 4. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
 5. Speed Settings and Control: Variable speed with a speed range of at least 75 percent.
 6. Vibration Control: Integral isolation to dampen vibration transmission.
- F. Drain Pan: If required by manufacturer's design, provide unit with non-ferrous drain pan with bottom sloped to a low point drain connection.
- G. Unit Controls:
1. Enclosure: Manufacturer's standard, and suitable for unprotected outdoor locations.

2. Factory-Installed Controller: Configurable digital control.
 3. Factory-Installed Sensors:
 - a. Refrigerant suction temperature.
 - b. Refrigerant discharge temperature.
 - c. Outdoor air temperature.
 - d. Refrigerant high pressure.
 - e. Refrigerant low pressure.
 - f. Oil level.
 4. Features and Functions: Self-diagnostics, time delay, auto-restart, fuse protection, auto operation mode equalize run time between multiple same components.
 5. Communication: Network communication with indoor units and other outdoor unit(s).
 6. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
 7. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
- H. Unit Electrical:
1. Enclosure: Metal, similar to enclosure, and suitable for unprotected outdoor locations.
 2. Field Connection: Single point connection to power entire unit and integral controls.
 3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
 4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
 5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
 6. Raceways: Enclose line voltage wiring in raceways to comply with NFPA 70.
- I. Unit Hardware: Zinc-plated steel, or stainless steel.
- J. Unit Piping:
1. Unit Tubing: Copper tubing with brazed joints.
 2. Unit Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
 3. Field Piping Connections: Manufacturer's standard.
 4. Factory Charge: Dehydrated air or nitrogen.
 5. Testing: Factory pressure tested and verified to be without leaks.

2.7 HEAT RECOVERY CONTROL UNITS (HRCUs)

- A. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.
1. Specially designed for use in systems with simultaneous heating and cooling.
 2. Systems shall consist of one unit, or multiple unit that are designed by variable refrigerant system manufacturer for field interconnection to make a single refrigeration circuit that connects multiple indoor units.
- B. Cabinet:
1. Galvanized-steel construction.
 2. Insulation: Manufacturer's standard internal insulation to provide thermal resistance and prevent condensation.
 3. Mounting: Manufacturer-designed provisions for field installation.
 4. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

- C. Drain Pan: If required by manufacturer's design, provide unit with non-ferrous drain pan with bottom sloped to a low point drain connection.
- D. Refrigeration Assemblies and Specialties:
 - 1. Specially designed by manufacturer for type of VRF HVAC system being installed, either two or three pipe.
 - 2. Each refrigerant branch circuit shall have refrigerant control valve(s) to control refrigerant flow.
 - 3. Spares: Each heat recovery control unit shall include at least two branch circuit port(s) for future use.
 - 4. Each system piping connection upstream of heat recovery unit shall be fitted with an isolation valve to allow for service to any heat recovery control unit in the system without interrupting operation of the system.
 - 5. Each branch circuit connection shall be fitted with an isolation valve and capped service port to allow for service to any individual branch circuit without interrupting operation of the system.
 - a. If not available as an integral part of the heat recovery control unit, isolation valves shall be field installed adjacent to the unit pipe connection.
- E. Unit Controls:
 - 1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
 - 2. Factory-Installed Controller: Configurable digital control.
 - 3. Features and Functions: Self-diagnostics, fuse protection, .
 - 4. Communication: Network communication with indoor units and outdoor unit(s).
 - 5. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
 - 6. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
- F. Unit Electrical:
 - 1. Enclosure: Metal, similar to enclosure, and suitable for indoor locations.
 - 2. Field Connection: Single point connection to power entire unit and integral controls.
 - 3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
 - 4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
 - 5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
 - 6. Raceways: Enclose line voltage wiring in raceways to comply with NFPA 70.
- G. Unit Piping:
 - 1. Unit Tubing: Copper tubing with brazed joints.
 - 2. Unit Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
 - 3. Field Piping Connections: Manufacturer's standard.
 - 4. Factory Charge: Dehydrated air or nitrogen.
 - 5. Testing: Factory pressure tested and verified to be without leaks.

2.8 SYSTEM CONTROLS

- A. General Requirements:
 - 1. Network: Indoor units, HRCUs, and outdoor units shall include integral controls and connect through a TIA-485A or manufacturer-selected control network.
 - 2. Network Communication Protocol: Manufacturer proprietary control communication between interconnected units.
 - 3. Integration with Building Automation System: ASHRAE 135, BACnet IP and certified by BACnet Testing Lab (BTL), including the following:

- a. Ethernet connection via RJ-45 connectors and port with transmission at 100 Mbps or higher.
 - b. Integration devices shall be connected to local uninterruptible power supply unit(s) to provide at least 5 minutes of battery backup operation after a power loss.
 - c. Integration shall include control monitoring scheduling and change of value notifications.
- B. VRF HVAC System Operator Software for PC:
- 1. Software offered by VRF HVAC system manufacturer shall provide system operators with ability to monitor and control VRF HVAC system(s) from a single dedicated Owner-furnished PC.
 - 2. Software shall provide operator with a graphic user interface to allow monitoring and control of multiple central controllers from a single device location through point-and-click mouse exchange.
 - 3. Plan views shall show building plans with location of indoor units and identification superimposed on plans.
 - 4. Controls operation mode of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units. Operation modes available through central controller shall match those operation modes of controllers for indoor units.
 - 5. Schedules operation of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units. Schedules daily, weekly, and annual events.
 - 6. Changes operating set points of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units.
 - 7. Optimized start feature to start indoor units before scheduled time to reach temperature set-point at scheduled time based on operating history.
 - 8. Night setback feature to operate indoor units at energy-conserving heating and cooling temperature set-points during unoccupied periods.
 - 9. Displays service notifications and error codes.
 - 10. Monitors and displays up to 3000 item error history and 10000 item operation history for regular reporting and further archiving.
 - 11. Monitors and displays cumulative operating time of indoor units.
 - 12. Able to disable and enable operation of individual controllers for indoor units.
 - 13. Information displayed on individual controllers shall also be available for display.
 - 14. Information displayed for outdoor units, including refrigerant high and low pressures percent capacity.

2.9 SYSTEM REFRIGERANT AND OIL

- A. Refrigerant:
 - 1. As required by VRF HVAC system manufacturer for system to comply with performance requirements indicated.
 - 2. ASHRAE 34, Class A1 refrigerant classification.
 - 3. R-410a.
- B. Oil:
 - 1. As required by VRF HVAC system manufacturer and to comply with performance requirements indicated.

2.10 SYSTEM CONDENSATE-DRAIN PIPING

- A. Connect unit condensate drain to existing condensate runout with flexible tubing turned in a loop for trap.

2.11 SYSTEM HYDRONIC PIPING

- A. Comply with requirements in Section 23 21 13 "Hydronic Piping" for system piping requirements.

2.12 SYSTEM REFRIGERANT PIPING

- A. Refrigerant Piping:
 - 1. Copper Tube: ASTM B280, Type ACR.
 - 2. Wrought-Copper Fittings: ASME B16.22.
 - 3. Brazing Filler Metals: AWS A5.8/A5.8M.
- B. Refrigerant Tubing Kits:
 - 1. Furnished by VRF HVAC system manufacturer.
 - 2. Factory-rolled and -bundled, soft-copper tubing with tubing termination fittings at each end.
 - 3. Standard one-piece length for connecting to indoor units.
 - 4. Pre-insulated with flexible elastomeric insulation of thickness to comply with governing energy code and sufficient to eliminate condensation.
 - 5. Factory Charge: Dehydrated air or nitrogen.
- C. Divided-Flow Specialty Fittings: Where required by VRF HVAC system manufacturer for proper system operation, VRF HVAC system manufacturer shall furnish specialty fittings with identification and instructions for proper installation by Installer.
- D. Refrigerant Isolation Ball Valves:
 - 1. Description: Uni-body full port design, rated for maximum system temperature and pressure, and factory tested under pressure to ensure tight shutoff. Designed for valve operation without removing seal cap.
 - 2. Seals: Compatible with system refrigerant and oil. Seal service life of at least 20 years.
 - 3. Valve Connections: Flare or sweat depending on size.

2.13 METAL HANGERS AND SUPPORTS

- A. Copper Tube Hangers:
 - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
 - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of galvanized or copper-coated steel.

2.14 OUTDOOR EQUIPMENT STANDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eberl Iron Works, Inc.
 - 2. MIRO Industries.
 - 3. RectorSeal HVAC; a CSW Industrials Company.
- B. Description: Individual foot supports with elevated adjustable channel cross bars and clamps/fasteners/bolts for ground or roof-supported outdoor equipment components, without roof membrane penetration, in a prefabricated system that can be modularly assembled on-site.
- C. Foot Material: Rubber or polypropylene.
- D. Rails Material: Hot-dip galvanized carbon steel.

2.15 PIPING AND TUBING INSULATION

- A. Comply with requirements in Section 23 07 19 "HVAC Piping Insulation" for system piping insulation requirements.
- B. Condensate-Drain Piping and Tubing Insulation and Jacket Requirements:
 - 1. Flexible Elastomeric Insulation:
 - a. Closed-cell, sponge- or expanded-rubber materials, complying with ASTM C534, Type I for tubular materials.
 - b. Indoors: 1/2 inch thick.
- C. Refrigerant Tubing Insulation and Jacket Requirements:
 - 1. Flexible Elastomeric Insulation:
 - a. Closed-cell, sponge- or expanded-rubber materials, complying with ASTM C534, Type I for tubular materials.
 - b. Indoors: 1 inch thick.
 - c. Outdoors: 1 inch thick.
 - 2. Field-Applied Jacket:
 - a. Concealed: None required.
 - b. Indoors, Exposed to View: None required.
 - c. Outdoors, Exposed to View: Aluminum, smooth, 0.020 inch thick.

2.16 SYSTEM CONTROL CABLE

- A. Cable Rating: Listed and labeled for application according to NFPA 70.
 - 1. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262, by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.
 - a. Flame Travel Distance: 60 inches or less.
 - b. Peak Optical Smoke Density: 0.5 or less.
 - c. Average Optical Smoke Density: 0.15 or less.
 - 2. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.
 - 3. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.
- B. Low-Voltage Control Cabling:
 - 1. Paired Cable: NFPA 70, Type CMG.
 - a. One pair, twisted, No. 16 AWG, stranded (19x29) or No. 18 AWG, stranded (19x30) tinned-copper conductors as required by VRF HVAC system manufacturer.
 - b. PVC insulation.
 - c. Braided or foil shielded.
 - d. PVC jacket.
 - e. Flame Resistance: Comply with UL 1685.
 - 2. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
 - a. One pair, twisted, No. 16 AWG, stranded (19x29) or No. 18 AWG, stranded (19x30) tinned-copper conductors as required by VRF HVAC system manufacturer.
 - b. PVC insulation.
 - c. Braided or foil shielded.
 - d. PVC jacket.
 - e. NFPA 262 includes the standard flame-resistance test criteria in common use for cables and conductors.
 - f. Flame Resistance: Comply with NFPA 262.
- C. TIA-485A Network Cabling:
 - 1. Standard Cable: NFPA 70, Type CMG.

- a. Paired, one pair or two pairs, twisted, No. 22 AWG, stranded (7x30) tinned-copper conductors.
- b. PVC insulation.
- c. Unshielded.
- d. PVC jacket.
- e. Flame Resistance: Comply with UL 1685.
- 2. Plenum-Rated Cable: NFPA 70, Type CMP.
 - a. Paired, one pair or two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
 - b. Fluorinated ethylene propylene insulation.
 - c. Unshielded.
 - d. Fluorinated ethylene propylene jacket.
 - e. NFPA 262 includes the standard flame-resistance test criteria in common use for cables and conductors.
 - f. Flame Resistance: NFPA 262.
- D. Ethernet Network Cabling: TIA-568-C.2 Category 6a cable with RJ-45 connectors.
 - 1. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of category cable indicated.
 - 2. Conductors: 100-ohm, 23 AWG solid copper.
 - 3. Shielding: Shielded twisted pairs (FTP).
 - 4. Cable Rating: By application.
 - 5. Jacket: Gray thermoplastic.

2.17 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect factory-assembled equipment.
- B. Equipment will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports for historical record. Submit reports only if requested.

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 the Work.
- B. Examine products before installation. Reject products that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for piping and tubing to verify actual locations of connections before equipment installation.
- D. Examine roughing-in for ductwork to verify actual locations of connections before equipment installation.
- E. Examine roughing-in for wiring and conduit to verify actual locations of connections before equipment installation.
- F. Examine walls, floors, roofs, and outdoor pads for suitable conditions where equipment will be installed.
- G. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

- H. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION, GENERAL

- A. Clearance:
 - 1. Maintain manufacturer's recommended clearances for service and maintenance.
 - 2. Maintain clearances required by governing code.
- B. Loose Components: Install components, devices, and accessories furnished by manufacturer, with equipment that are not factory mounted.
 - 1. Loose components shall be installed by manufacturer's service representative or system Installer under supervision of manufacturer's service representative.

3.3 INSTALLATION OF INDOOR UNITS

- A. Install units to be level and plumb while providing a neat and finished appearance.
- B. Unless otherwise required by VRF HVAC system manufacturer, support ceiling-mounted units from structure.
- C. Adjust supports of exposed and recessed units to draw units tight to adjoining surfaces.
- D. Protect finished surfaces of ceilings, floors, and walls that come in direct contact with units. Refinish or replaced damaged areas after units are installed.
- E. In rooms with ceilings, conceal piping and tubing, controls, and electrical power serving units above ceilings.
- F. In rooms without ceiling, arrange piping and tubing, controls, and electrical power serving units to provide a neat and finished appearance.
- G. Attachment: Install hardware for proper attachment to supported equipment.

3.4 INSTALLATION OF OUTDOOR UNITS

- A. Install units to be level and plumb while providing a neat and finished appearance.
- B. Install outdoor units on support structures indicated on Drawings.
- C. Roof-Mounted Installations: Install outdoor units on equipment supports. Anchor units to supports with removable, stainless-steel fasteners.

3.5 INSTALLATION OF HYDRONIC PIPING

- A. Comply with requirements for hydronic pipe and tubing specified in Section 23 21 13 "Hydronic Piping."
- B. Comply with requirements for hydronic specialties specified in Section 23 21 16 "Hydronic Piping Specialties."
- C. Comply with requirements for ball valves specified in Section 23 05 23.12 "Ball Valves for HVAC Piping."
- D. Install continuous-thread hanger rods and elastomeric hangers of size required to support equipment weight.
 - 1. Comply with requirements for hangers and supports specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."

- E. Where installing piping and tubing adjacent to equipment, allow space for service and maintenance.

3.6 INSTALLATION OF REFRIGERANT PIPING

- A. Refrigerant Tubing Kits:
 - 1. Unroll and straighten tubing to suit installation. Deviations in straightness of exposed tubing shall be unnoticeable to observer.
 - 2. Support tubing using hangers and supports indicated at intervals not to exceed 5 feet. Minimum rod size, 1/4 inch.
 - 3. Prepare tubing ends and make mating connections to provide a pressure tight and leak-free installation.
- B. Install refrigerant piping according to ASHRAE 15 and governing codes.
- C. Select system components with pressure rating equal to or greater than system operating pressure.
- D. Install piping as short and direct as possible, with a minimum number of joints and fittings.
- E. Arrange piping to allow inspection and service of equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as required.
- F. Install refrigerant piping and tubing in rigid or flexible conduit in locations where exposed to mechanical damage.
- G. Unless otherwise required by VRF HVAC system manufacturer, slope refrigerant piping and tubing as follows:
 - 1. Install horizontal hot-gas discharge piping and tubing with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- H. When brazing, remove or protect components that could be damaged by heat.
- I. Before installation, clean piping, tubing, and fittings to cleanliness level required by VRF HVAC system manufacturer.
- J. Joint Construction:
 - 1. Ream ends of tubes and remove burrs.
 - 2. Remove scale, slag, dirt, and debris from inside and outside of tube and fittings before assembly.
 - 3. Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
 - a. Use Type BCuP (copper-phosphorus) alloy for joining copper fittings with copper tubing.
 - b. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze.

3.7 INSTALLATION OF PIPING AND TUBING INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated. Installation to maintain a continuous vapor barrier.
- B. Insulation Installation on Pipe Fittings and Elbows:
 - 1. Install mitered sections of pipe insulation.

2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 2. When preformed valve covers are unavailable, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.8 SOFTWARE

- A. Cybersecurity:
1. Software:
 - a. Coordinate security requirements with IT department.
 - b. Ensure that latest stable software release is installed and properly operating.
 - c. Disable or change default passwords to password using a combination of uppercase and lower letters, numbers, and symbols at least eight characters in length. Record passwords and turn over to party responsible for system operation and administration.
 2. Hardware:
 - a. Coordinate location and access requirements with IT department.
 - b. Enable highest level of wireless encryption that is compatible with Owner's ICT network.
 - c. Disable dual network connections.

3.9 INSTALLATION OF SYSTEM CONTROL CABLE

- A. Comply with NECA 1.
- B. Installation Method:
1. Install cables in raceways except as follows:
 - a. Within equipment and associated control enclosures.
 - b. In accessible ceiling spaces where open cable installation method may be used.
 - c. In gypsum board partitions where cable may be enclosed within wall cavity.
 2. Conceal raceway and cables except in unfinished spaces.
- C. General Requirements for Cabling:
1. Comply with TIA-568-C Series of standards.
 2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems."
 3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
 4. Cables may not be spliced and shall be continuous from terminal to terminal. Do not splice cable.

5. Cables serving a common system may be grouped in a common raceway. Install control cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
 6. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 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 ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.
 8. Do not install bruised, kinked, scored, deformed, or abraded cable. 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. Do not use heat lamps for heating.
 10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Monitor cable pull tensions.
 11. Support: Do not allow cables to lie on removable ceiling tiles or access panels.
 12. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
 13. Provide strain relief.
 14. Keep runs short. Allow extra length for connecting to terminals.
 15. Do not bend cables in a radius less than 10 times the cable OD.
 16. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
 17. Ground wire shall be copper, and grounding methods shall comply with IEEE C2. Demonstrate ground resistance.
- D. Balanced Twisted-Pair Cable Installation:
1. Comply with TIA-568-C.2.
 2. Do not untwist balanced twisted-pair cables more than 1/2 inch at the point of termination to maintain cable geometry.
- E. Open-Cable Installation:
1. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 30 inches apart.
 2. Cable shall not be run through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.
- F. Separation from EMI Sources: Comply with BICSI TDMM and TIA-569-D recommendations for separating unshielded cable from potential EMI sources including electrical power wiring and equipment.

3.10 GROUNDING INSTALLATION

- A. For data communication wiring, comply with TIA-607-B and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.

3.11 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage VRF HVAC system manufacturer's service representative to advise and assist installers; witness testing; and observe and inspect components, assemblies, and equipment installations, including controls and connections.
1. Field service shall be performed by a factory-trained and -authorized service representative of VRF HVAC system manufacturer whose primary job responsibilities are to provide direct technical support of its products.
 - a. Additional factory-authorized representatives may assist with completion of certain activities only if supervised by manufacturer's employee. A

factory-authorized representative shall not provide assistance without manufacturer's employee supervision.

2. Manufacturer shall provide on-site visits during the course of construction at installation milestones indicated. System Installer shall coordinate each visit in advance to give manufacturer sufficient notice to plan the visit.
3. Final Inspection before Startup:
 - a. Before inspection, Installer to provide written request to manufacturer stating the system is fully installed according to manufacturer's requirements and ready for final inspection.
 - b. All system equipment and operating components shall be inspected. If components are inaccessible for inspection, they shall be made accessible before the final inspection can be completed.
 - c. Manufacturer shall provide a comprehensive inspection of all equipment and each operating component that comprise the complete system(s). Inspection shall follow a detailed checklist specific to each equipment and operating component.
 - d. Inspection reports for indoor units shall include, but not be limited to, the following:
 - 1) Unit designation on Drawings.
 - 2) Manufacturer model number.
 - 3) Serial number.
 - 4) Network address, if applicable.
 - 5) Each equipment setting.
 - 6) Mounting, supports, and restraints properly installed.
 - 7) Proper service clearance provided.
 - 8) Wiring and power connections correct.
 - 9) Line-voltage reading(s) within acceptable range.
 - 10) Wiring and controls connections correct.
 - 11) Low-voltage reading(s) within an acceptable range.
 - 12) Controller type and model controlling unit.
 - 13) Controller location.
 - 14) Temperature settings and readings within an acceptable range.
 - 15) Humidity settings and readings within an acceptable range.
 - 16) Condensate removal acceptable.
 - 17) Fan settings and readings within an acceptable range.
 - 18) Unit airflow direction within an acceptable range.
 - 19) If applicable, fan external static pressure setting.
 - 20) Filter type and condition acceptable.
 - 21) Noise level within an acceptable range.
 - 22) Refrigerant piping properly connected and insulated.
 - 23) Condensate-drain piping properly connected and insulated.
 - 24) If applicable, ductwork properly connected.
 - 25) If applicable, external interlocks properly connected.
 - 26) Remarks.
 - e. Inspection reports for outdoor units shall include, but not be limited to, the following:
 - 1) Unit designation on Drawings.
 - 2) Manufacturer model number.
 - 3) Serial number.
 - 4) Network address, if applicable.
 - 5) Each equipment setting.
 - 6) Mounting, supports, and restraints properly installed.
 - 7) Proper service clearance provided.
 - 8) Wiring and power connections correct.
 - 9) Line-voltage reading(s) within acceptable range.
 - 10) Wiring and controls connections correct.
 - 11) Low-voltage reading(s) within an acceptable range.
 - 12) Condensate removal acceptable.
 - 13) Noise level within an acceptable range.

- 14) Refrigerant piping properly connected and insulated.
 - 15) Condensate-drain piping properly connected and insulated.
 - 16) Remarks.
- f. Installer shall provide manufacturer with the requested documentation and technical support during inspection.
 - g. Installer shall correct observed deficiencies found by the inspection.
 - h. Upon completing the on-site inspection, manufacturer shall provide a written report with complete documentation describing each inspection step, the result, and any corrective action required.
 - i. If corrective action is required by Installer that cannot be completed during the same visit, provide additional visits, as required, until deficiencies are resolved, and systems are deemed ready for startup.
 - j. Final report shall indicate the system(s) inspected are installed according to manufacturer's requirements and are ready for startup.
- B. Perform the following tests and inspections with the assistance of manufacturer's service representative:
- 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Refrigerant Tubing Positive Pressure Testing:
- 1. Comply with more stringent of VRF HVAC system manufacturer's requirements and requirements indicated.
 - 2. After completion of tubing installation, pressurize tubing systems to a test pressure of not less than 1.5 times VRF HVAC system operating pressure, but not less than 600 psig, using dry nitrogen.
 - 3. Successful testing shall maintain a test pressure for a continuous and uninterrupted period of 24 hours. Allowance for pressure changes attributed to changes in ambient temperature are acceptable.
 - 4. Prepare test report to record the following information for each test:
 - a. Name of person starting test, company name, phone number, and e-mail address.
 - b. Name of manufacturer's service representative witnessing test, company name, phone number, and e-mail address.
 - c. Detailed description of extent of tubing tested.
 - d. Date and time at start of test.
 - e. Test pressure at start of test.
 - f. Outdoor temperature at start of test.
 - g. Name of person ending test, company name, phone number, and e-mail address.
 - h. Date and time at end of test.
 - i. Test pressure at end of test.
 - j. Outdoor temperature at end of test.
 - k. Remarks:
 - 5. Submit test reports for Project record.
- D. Refrigerant Tubing Evacuation Testing:
- 1. Comply with more stringent of VRF HVAC system manufacturer's requirements and requirements indicated.
 - 2. After completion of tubing positive-pressure testing, evacuate tubing systems to a pressure of 500 microns.
 - 3. Successful testing shall maintain a test pressure for a continuous and uninterrupted period of one hour(s) with no change.

4. Prepare test report to record the following information for each test:
 - a. Name of person starting test, company name, phone number, and e-mail address.
 - b. Name of manufacturer's service representative witnessing test, company name, phone number, and e-mail address.
 - c. Detailed description of extent of tubing tested.
 - d. Date and time at start of test.
 - e. Test pressure at start of test.
 - f. Outdoor temperature at start of test.
 - g. Name of person ending test, company name, phone number, and e-mail address.
 - h. Date and time at end of test.
 - i. Test pressure at end of test.
 - j. Outdoor temperature at end of test.
 - k. Remarks:
 5. Submit test reports for Project record.
 6. Upon successful completion of evacuation testing, system shall be charged with refrigerant.
- E. System Refrigerant Charge:
1. Using information collected from the refrigerant tubing evacuation testing, system Installer shall consult variable refrigerant system manufacturer to determine the correct system refrigerant charge.
 2. Installer shall charge system following VRF HVAC system manufacturer's written instructions.
 3. System refrigerant charging shall be witnessed by system manufacturer's representative.
 4. Total refrigerant charge shall be recorded and permanently displayed at the system's outdoor unit.
- F. Products will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports.

3.12 STARTUP SERVICE

- A. Engage a VRF HVAC system manufacturer's service representative to perform system(s) startup service.
1. Service representative shall be a factory-trained and -authorized service representative of VRF HVAC system manufacturer.
 2. Complete startup service of each separate system.
 3. Complete system startup service according to manufacturer's written instructions.
- B. Startup checks shall include, but not be limited to, the following:
1. Check control communications of equipment and each operating component in system(s).
 2. Check each indoor unit's response to demand for cooling and heating.
 3. Check each indoor unit's response to changes in airflow settings.
 4. Check each indoor unit, HRCU, and outdoor unit for proper condensate removal.
- C. Installer shall accompany manufacturer's service representative during startup service and provide manufacturer's service representative with requested documentation and technical support during startup service.
1. Installer shall correct deficiencies found during startup service for reverification.
- D. System Operation Report:
1. After completion of startup service, manufacturer shall issue a report for each separate system.

2. Report shall include complete documentation describing each startup check, the result, and any corrective action required.

3.13 ADJUSTING

- A. Adjust equipment and components to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust initial temperature and humidity set points. Adjust initial airflow settings and discharge airflow patterns.
- C. Set field-adjustable switches and circuit-breaker trip ranges according to VRF HVAC system manufacturer's written instructions, and as indicated.

3.14 PROTECTION

- A. Protect products from moisture and water damage. Remove and replace products that are wet, moisture damaged, or mold damaged.
- B. Protect equipment from physical damage. Replace equipment with physical damage that cannot be repaired to new condition. Observable surface imperfections shall be grounds for removal and replacement.
- C. Protect equipment from electrical damage. Replace equipment suffering electrical damage.
- D. Cover and seal openings of equipment to keep inside of equipment clean. Do not remove covers until finish work is complete.

3.15 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
 1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.16 DEMONSTRATION

- A. Engage a VRF HVAC system manufacturer's factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain entire system.
- B. Instructor:
 1. Instructor shall be factory trained and certified by VRF HVAC system manufacturer with current training on the system(s), equipment, and controls that are installed.
 2. Instructor's credentials shall be submitted for review by Commissioning Agent and Owner before scheduling training.
 3. Instructor(s) shall have not less than three years of training experience with VRF HVAC system manufacturer and past training experience on at least three projects of comparable size and complexity.

- C. Schedule and Duration:
 - 1. Schedule training with Owner at least 20 business days before first training session.
 - 2. Training shall occur before Owner occupancy.
 - 3. Training shall be held at mutually agreed date and time during normal business hours.

- D. Location: Owner shall provide a suitable on-site location to host classroom training.

- E. Acceptance: Obtain Commissioning Agent written acceptance that training is complete, and requirements indicated have been satisfied.

END OF SECTION

SECTION 23 82 13

VALANCE HEATING AND COOLING UNITS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Hydronic heating panels.

1.2 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, specialties, and accessories for each product indicated.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, details, and attachments to other work. Detail equipment assemblies and suspension and attachment.
 - 2. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 HYDRONIC HEATING AND COOLING PANELS

- 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. AIRTEX Radiant Systems.
 - 2. Rosemex Products.
 - 3. Sun-El Corporation.
 - 4. Twa Panel Systems, inc.
 - 5. Aerotech
- B. Description: Modular sheet-metal panel with serpentine water piping, suitable for lay-in installation flush with T-bar ceiling grid or recessed mounting.
 - 1. Panels: Minimum 0.0336-inch-thick, galvanized-steel sheet.
 - 2. Backing Insulation: Minimum R=3.5, mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB with factory-applied jacket.
 - 3. Exposed-Side Panel Finish: Powder-coat-enamel finish in manufacturer's standard paint color as selected by Architect.
 - 4. Factory Piping: Copper tube with ASME B16.22 wrought-copper fittings and brazed joints. Piping shall be mechanically bonded to panel.
- C. Capacities and Characteristics: As scheduled on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install radiant heating units' level and plumb.

- B. Suspend radiant heaters from structure.
- C. Coordinate layout and installation of radiant heaters and suspension-system components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, communications system, security system, and partition assemblies.
- D. Support for Radiant Heating Panels in or on Grid-Type Suspended Ceilings: Use grid as a support element.
 - 1. Install a minimum of four ceiling support-system rods or wires for each panel. Locate not more than 6 inches from panel corners.
 - 2. Support Clips: Fasten to panel and to ceiling grid members at or near each panel corner with clips designed for the application.
 - 3. Panels of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans, or center in acoustical panel and support panels independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
- E. Piping installation requirements are specified in Section 23 21 13 "Hydronic Piping" and Section 23 21 16 "Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.
- F. Unless otherwise indicated, install shutoff valve and union or flange at each connection.
- G. Install piping adjacent to unit to allow service and maintenance.

3.2 FIELD QUALITY CONTROL

- A. After installing panels, inspect unit cabinet for damage to finish. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Prepare test and inspection reports.

END OF SECTION

SECTION 26 00 10

GENERAL REQUIREMENTS FOR ELECTRICAL

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 the Work of this Division. "This Division" in this Section shall mean Divisions 26, 27, and 28 unless specifically indicated otherwise.
 - 1. The intent of this Section is to complement Division 01 Specifications and to provide supplementary, trade-specific information.
 - 2. Refer conflicting requirements to Architect for a decision before proceeding. If a resolution is not obtained, assume the costliest to apply.
- B. Thoroughly study all Drawings and Specifications before submitting bids.
- C. Drawings and Specifications are to be considered as supplementing each other. Work specified but not shown or shown but not specified shall be performed or furnished as though mentioned in both Specifications and Drawings.
- D. Details on Drawings are to be considered typical for similar applications unless specifically noted otherwise.

1.2 SUMMARY

- A. Bid shall include the cost of all labor, materials, tools, transportation, equipment, insurance, temporary protection, rentals, permits, taxes, and all necessary and miscellaneous items required to provide various systems shown and described complete and in good operating condition whether or not these miscellaneous items are specifically described in the Specifications or shown on the Drawings.
- B. Install all work in accordance with all applicable codes and prepare supplemental detail drawings and Shop Drawings reflecting purchased equipment requirements as necessary to obtain approval of authorities having jurisdiction over this Project.
- C. Guarantee workmanship, materials, and performance of this Division's systems in accordance with the requirements of the Contract Documents.
- D. The following are specifically included without limiting the generality implied by the Drawings or Specifications:
 - 1. Electrical systems (Division 26) including:
 - a. Low-voltage electrical power conductors and cables.
 - b. Grounding and bonding.
 - c. Hangers and supports.
 - d. Raceways and boxes.
 - e. Underground ducts and raceways.
 - f. Identification for electrical systems.
 - g. Lighting control devices.
 - h. Low-voltage electrical transmission, including distribution panels, panelboards, transformers, transient voltage suppression devices, switching and protective equipment, and grounding.
 - i. Panelboards.
 - j. Wiring devices.
 - k. Enclosed switches and circuit breakers.
 - l. Manual and magnetic motor controllers.
 - m. Interior, exterior, emergency and exit, athletic field lighting.

2. Communications systems (Division 27) including:
 - a. Data network system.
3. Electronic safety and security systems (Division 28) including:
 - a. Addressable fire-alarm system.
4. Coordinate all electric work associated with power company, telephone company, and cable television company.
5. Earth moving for electrical, communications, and electronic safety and security, including trenching and backfilling and concrete and reinforcing work for electric services, fiberoptic service, telephone service, transformer pad, pole bases, and miscellaneous items. Concrete work is specified in Division 03.
6. Apply firestopping to penetrations of fire-rated construction, to restore original fire-resistance rating of assembly, and as indicated in this Division's Specifications. Comply with requirements in this Section.
7. Submittal of forms and Drawings to review and permit agencies.
8. Submittals.
9. Record Documents.
10. Permits and Inspections: Apply for and obtain all required permits and inspections for all work in this Contract; pay all related fees and charges.
11. Electric Service-Entrance Charges:
 - a. Permanent: Owner will pay fees for permanent electric service.

1.3 ALLOWANCES

- A. Refer to Division 01 Specifications.

1.4 UNIT PRICES

- A. Refer to Division 01 Specifications.

1.5 ALTERNATES

- A. Refer to Division 01 Specifications.

1.6 PROJECT MANAGEMENT AND COORDINATION

- A. General Requirements:
 1. Drawings show general design arrangement; install work substantially as indicated. Verify exact location and elevations on job. DO NOT SCALE DRAWINGS.
 2. Due to small scale of Drawings, it is not possible to indicate all offsets, fittings, changes in elevation, interferences, etc. Adjust installation of piping, ductwork, conduit, equipment locations, etc., to accommodate work with obstacles and interferences encountered.
 3. Advise the Construction Manager in timely manner of questions on equipment locations, heights, etc.
 4. Any reasonable location adjustment of equipment and associated services requested by the Architect/ Construction Manager, prior to work being installed, shall be done with no cost added to the Contract.
- B. Coordination with Other Divisions:
 1. Provide to other Divisions any information related to their appropriate trade concerning the equipment or any work of this Contract in ample time to prevent delay in building progress.
 2. Interference:
 - a. Thoroughly coordinate work with other Divisions and:
 - 1) Determine exact route or location of each piece of equipment, associated services, etc., before fabrication and installation.
 - 2) Maintain maximum headroom.

- 3) Obtain Engineer's review before installing any work below 7'-0" clear headroom in mechanical areas.
 - 4) Install work of this Division so that all equipment is serviceable and operable.
 - b. Should Architect's details, field conditions, changes in equipment, or Shop Drawing information necessitate an important rearrangement, advise Architect and act in accordance with his directions.
- C. Coordination with Drawings: Review all Drawings and if necessary, request copies of Shop Drawings to coordinate work. If potential conflict occurs between this Division's Drawings and another Drawing, advise Construction Manager and Architect in writing. Do not proceed with work without written directive from Contract-designated authority.
- D. Scheduling and Procedure of Work:
 - 1. The work of this Division shall be completed in accordance with Project schedule; otherwise, the Construction Manager shall have the right to install, at this Division's expense, any temporary work of this Division necessary to meet the scheduled completion date.
 - 2. As work occurs within or attached to existing structures:
 - a. Perform all work only on approved schedule.
 - b. Do not interfere with normal operation of existing systems.
 - c. Do not shut off any services without written authorization of Construction Manager.
 - d. Do as much work as possible prior to the shutdown to minimize the downtime.
 - e. Make temporary connections as necessary to maintain schedule agreed upon, with no cost added to the Contract.
 - 3. No radios, tape players, compact disc players, etc., shall be permitted on-site.
 - 4. Proper work attire shall be worn at all times.
 - 5. All Contractor personnel working at the Project site must obtain and display a valid identification badge. All vehicles must display a valid parking permit. Refer to Division 01 Specifications for additional requirements, such as parking permits and identification badges.

1.7 SUBMITTALS

- A. Supply submittals indicated in each Section of this Division's Specifications and in accordance with requirements of Division 01 Specifications. Supply separate submittals for each Section of Specifications and for each building.
- B. Wiring Diagrams: Electrically operated equipment shall include factory-approved wiring diagram illustrating proper connections to be made between equipment and power and equipment and auxiliary controls (where applicable).
- C. Penetration Firestopping: Submit product data and installer certificates signed by installer certifying that products have been installed in compliance with requirements.
- D. Clearly label each submittal with item name/description; Specifications' section, paragraph and/or subparagraph; and any pertinent Drawing detail reference information.
- E. Submit field quality-control reports when indicated in Part 3 of Division's Specifications.

1.8 QUALITY REQUIREMENTS

- A. Contractor shall be licensed in accordance with New York State General Business Law, Article 6-D.

- B. Observation of the Work:
 - 1. Architect/Engineer may make periodic visits to the job site to observe the general progress and quality of the work. Architect/Engineer will not make continuous or detailed on-site inspections to check the quality and/or quantity of work and will not be responsible for this Division's failure to carry out construction work in accordance with the Contract Documents, Project schedule, or unsound construction procedures or practices.

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

- D. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not, including the following:
 - 1. Before request for final payment, submit to the New York State Education Department and the Architect a certificate of approval from one of the listed electrical inspection agencies:
 - a. Middle Department Inspection Agency.
 - b. Independent Consolidated Inspection Service, Inc.

1.9 REFERENCES

- A. Industry Standards:
 - 1. The following standards shall govern and shall constitute minimum requirements as approved. If the requirements of this Division's Specifications exceed those of the standards mentioned, this Division's Specifications shall govern.
 - a. Local and state building codes.
 - b. Local utility companies.
 - c. National Electrical Manufacturer's Association ("NEMA").
 - d. American Institute of Electronic and Electrical Engineers ("IEEE").
 - e. National Electrical Safety Code ("NESC").
 - f. National Electric Code ("NEC").
 - g. ETL, Factory Mutual ("FM"), or Underwriters Laboratories, Inc. ("UL"), approved or listed, wherever applicable to materials.
 - h. American National Standards Institute ("ANSI").
 - i. National Fire Protection Association ("NFPA").
 - j. Official Compilation of Codes, Rules and Regulations of the State of New York ("NYCRR") for education, health, and sanitary rules and regulations, including:
 - a) NFPA 101, Life Safety Code, 2015 edition (Part 711.2).
 - 1) Chapter XXXIII – State Fire Prevention and Building Code Council, including:
 - a) Subchapter A – Uniform Fire Prevention and Building Code (Uniform Code):
 - (1) Uniform Fire Prevention and Building Code (Part 1219).
 - (2) Residential Construction (Part 1220).
 - (3) Building Construction (Part 1221).
 - (4) Plumbing Systems (Part 1222).
 - (5) Mechanical Systems (Part 1223).
 - (6) Fuel Gas Equipment and Systems (Part 1224).
 - (7) Fire Prevention (Part 1225).
 - (8) Property Maintenance (Part 1226).
 - (9) Existing Buildings (Part 1227).
 - (10) The following documents by reference: 2020 Residential Code of New York State, 2020 Plumbing Code of New York

State, 2020 Mechanical Code of New York State, 2020 Building Code of New York State, 2020 Fire Code of New York State, 2020 Existing Building Code of New York State, 2020 Fuel Gas Code of New York State, and 2020 Property Maintenance Code of New York State.

- b) Subchapter B – State Energy Conservation Construction Code (Energy Code):
 - (1) State Energy Conservation Construction Code (Part 1240).
 - (2) The following documents by reference: 2020 Energy Conservation Construction Code, 2016 ASHRAE 90.1, and 2007 ASHRAE 183.
 - k. Federal Register Americans Disabilities Act ("ADA"); and ICC/ANSI A117.1, the Handicapped Accessibility Code.
 - l. New York State Education Department ("SED") "Manual of Planning Standards."
 - m. Lewis County Administrative Rules and Regulations.
 - n. Any other standards mentioned in this Division's Specifications.
- B. Materials and Equipment:
- 1. Electrical devices, materials, and packaged equipment shall be listed and labeled by UL, FM, or ETL for the intended use and shall bear their label.
 - 2. Plastic materials or equipment with plastic components cannot be installed or used in or as part of a building unless:
 - a. Such covered product complies with the requirements of Chapter 26 of the Building Code of New York State.
 - b. A report of such compliance has been filed with the Department of State in accordance with the Building Code of New York State.
- C. Before submitting bid, consult above codes, regulations, and requirements and make all necessary provisions for same in bid.

1.10 TEMPORARY FACILITIES AND CONTROLS

- A. Refer to Division 01 Specifications.
- B. Temporary Lighting and Power for Construction:
- 1. Provide complete, a 400-Amp, 208Y/120-volt, 3-phase, 4-wire temporary electric service on site for this Project. Extend this electric service from on-site utility company's temporary service utility pole, as required to provide and maintain a complete temporary lighting and power installation within the building which shall meet all necessary requirements of federal and local safety codes in addition to the National Electric Code.
 - 2. Provide within the main building structure rain-tight panelboards to provide lighting and outlets as described in Parts 2 and 3 of this Section.
 - 3. Provide electric services to all construction trailers and Owner's Representative's trailer in accordance with Division 01 Specifications.
 - 4. Provide all necessary branch circuitry required by temporary heating system(s).
 - 5. Payment for electrical energy used shall be as described in Division 01 Specifications.
- C. Fire Alarm System During Construction:
- 1. Maintain in operation the present building system. Prior to start of any construction, verify system status with Owner and document deficiencies.
 - 2. Upon completion of Project, present fire alarm system shall be in the same status as prior to construction.

1.11 PRODUCT REQUIREMENTS

- A. Refer to Division 01 Specifications.
- B. The term "product" shall mean items obtained for incorporating into the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes terms "materials," "equipment," "systems," and terms of similar intent.
- C. The Contract is based on products specified herein, shown on Drawings, and as authorized by addendum.
- D. Ensure all products conform to the Drawings and Specifications with regard to space requirements, performance, capacity, configuration, accessories, and materials of construction.
- E. Products furnished shall be new and, where used for similar purposes, of the same manufacturer. To the fullest extent possible, provide like products from a single source. If quantities from a single source cannot be provided, Architect/Engineer will make determination.
- F. Where the term "provide" is indicated, it shall have the same meaning as "furnish and install." All products listed shall be furnished and installed unless specifically noted to the contrary.
- G. Where the term "or equal" or "or approved equal" is indicated, it shall mean the same as "comparable product."
- H. Where "comparable product" is indicated, it shall mean a product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product. Contractor's request for comparable products will be considered when the following conditions are satisfied. If the following conditions are not satisfied, Engineer may return requests without action, except to record noncompliance with these requirements:
 - 1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 - 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - 3. Evidence that proposed product provides specified warranty.
 - 4. If requested, list of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 - 5. If requested, samples.
- I. Where the term "basis-of-design product," including manufacturer and model number or other designation, is indicated, intent is to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the Specifications. Bear responsibility and cost for changes made necessary by the use of products other than those of the basis-of-design product.
- J. Where the term "substitution" is indicated, it shall mean changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 1. The products described in the Contract Documents establish a standard of required function, dimensions, appearance, and quality to be met by any proposed substitution.

2. Contractor may make substitutions only with consent of Owner, after evaluation by the Architect/Engineer and in accordance with a Change Order.
 3. Substitution Procedures:
 - a. Follow substitution procedures indicated in Division 01 Specifications.
- K. Wherever subparagraph titles below introduce lists, the following requirements apply for product selection:
1. Available Manufacturers/Available Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers or products specified.
 - a. This is a non-restricted list. For unnamed manufacturer or unnamed product, product is considered a comparable product, not a substitution, and must be demonstrated and approved through submittal process.
 2. Manufacturers/Products: Subject to compliance with requirements, provide one of the specified products or products by one of specified manufacturers.
 - a. This is a restricted list. For unnamed manufacturer or unnamed product, product is considered a substitution.
 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product listed or a comparable product by one of the listed manufacturers.
 - a. Product by one of the listed manufacturers is considered a comparable product, not a substitution, and must be demonstrated and approved through submittal process.
 - b. For unnamed manufacturer or unnamed product, product is considered a substitution.
- L. Where "Manufacturer" or "Product" is indicated with only one named manufacturer or one named product, provide the product of the named manufacturer or the listed product. Comparable products or substitutions are not permitted.
- M. Justification for acceptance or rejection of unnamed products, unnamed manufacturers, comparable products, or product substitutions will not be demonstrated by the Architect/Engineer.
- N. Delivery, Storage, and Handling:
1. Deliver, store, and handle materials as recommended by the manufacturer.
 2. Handle and store materials in a manner which will not damage materials.
 3. Deliver and store materials throughout floor areas and in locations designated by Construction Manager. Provide blocking or pallets to prevent materials from becoming soiled.
 4. Schedule deliveries with Construction Manager prior to shipping.
 5. Be available at site to receive deliveries as scheduled.
 6. Hoist all materials as necessary to complete this Division's scope of work.
- O. Warranties:
1. Refer to Sections of this Division's Specifications for specific warranties.
 2. Refer to Division 01 Specifications for submittal of warranties.

1.12 EXECUTION

- A. Examination of Premises and Existing Conditions:
1. Examine all existing conditions affecting compliance with Drawings and Specifications by visiting site.
 2. Ascertain access to site, available storage, and delivery facilities.
 3. Verify all governing dimensions at site.
 4. Inspect all adjacent work.
 5. Verify the location, sizes, and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services; HVAC utility piping and other utilities.

6. No consideration shall be given for alleged misunderstandings. Proceeding with the work indicates acceptance of existing conditions.
- B. Roughing:
1. This Division's equipment shall be located generally as shown on Drawings; however, check actual field conditions to determine exact locations and avoid interference with other trades. Deviations from the Drawings proposed by this Division must be reviewed by the Construction Manager before the changes are made. Work improperly installed due to lack of construction verification shall be corrected at the expense of this Division.
 2. Before roughing for equipment furnished by others, obtain approved roughing drawings and exact location for each piece of equipment.
 3. Obtain Drawings or proper information giving final locations of all wiring, piping, ductwork, and motor and control connections.
 4. Unless otherwise detailed or specified:
 - a. All services shall be concealed in wall, above ceilings, etc.
 - b. Work shall be exposed only where approved by the Architect.
 - c. Notify Construction Manager and Architect if work cannot be concealed as intended.
- C. Cutting and Patching:
1. Provide removals, cutting, patching, and replacement required for installation of the work in this Contract, except as noted on the Architectural (A series) Drawings.
 - a. Provide patching for all existing openings caused by the removal of existing ducts, fixtures, equipment, piping, conduit, cable tray, supports, etc.
 2. Before proceeding, meet at Project site with parties involved in cutting and patching, including General Contractor; notify Construction Manager; review areas of potential interference and conflict; coordinate procedures; and resolve potential conflicts.
 3. Patch shall match existing finishes.
 4. Refer to Division 01 Specifications for additional requirements.
- D. Connections to Equipment Furnished by Others:
1. Various pieces of equipment will be furnished to the Project site and installed by other Divisions.
 2. Provide roughing-in and make final connections to equipment as indicated on the Drawings and/or as required.
 3. Before proceeding with the work, obtain full information regarding rough-in measurements, equipment layouts, elevations, trim being furnished, and other necessary data.
 4. Upon request, Construction Manager will provide this Division with diagrams, photographs, drawings, and/or specifications and other complete descriptive data showing all mechanical and electrical connections. Do not rough without approved layout from Construction Manager.
 5. Provide accessories so that connections may be made in a manner that shall meet all referenced regulations and codes.
 6. See appropriate Sections of this Division's Specifications for materials and methods.
- E. Adjustment of Systems:
1. Set aside in the cost breakdown a sum to cover work in adjusting and balancing distribution systems.
 2. No payment will be made for balancing until Work of this Division is completed to the satisfaction of the Owner and Construction Manager.

- F. Protection of Openings and Equipment:
1. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
 2. Protect equipment which is factory-finished using Kraft paper, cardboard, canvas, reinforced polyethylene, etc. Clean and repaint damaged factory finish, matching the original equipment finish.
 3. Protect all equipment openings during construction with temporary plugs, caps, or reinforced plastic.
 4. Adequately protect existing flooring material, door frames, stairs, wall, etc., during construction. Use any combination of materials, such as plywood, polyethylene sheeting, framing lumber, etc., so that existing finishes are protected. Repair damage to existing finishes that were not completely protected.
- G. Progress Cleaning: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1.13 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

- A. Salvage of Existing Materials: Obtain from Construction Manager a list of existing items being removed, to be delivered to on-site storage as directed. Remove from site and legally dispose of items not specifically noted on said list.
1. Dispose of existing lamps associated with luminaires to be removed in accordance with New York State and Federal guidelines and regulations for disposal of mercury-containing lamps.
 2. Dispose of existing ballasts associated with luminaires to be removed in accordance with New York State and Federal guidelines and regulations for disposal of fluorescent ballasts. All fluorescent ballasts shall be treated as hazardous waste unless the ballast clearly indicates that it contains no PCB.

1.14 CLOSEOUT PROCEDURES

- A. After all tests are made and installations pronounced satisfactory:
1. Thoroughly clean entire installation (both exposed surfaces and interiors) and leave in clean condition.
 2. Remove all debris caused by work.
 3. Promptly remove tools, surplus materials, and trailer when work is finally accepted.
- B. Repair damage to wall and to ceiling surface treatments caused by airborne dirt and debris from within ductwork systems.
- C. Receipts for Loose Equipment:
1. Prior to request for final payment:
 - a. Deliver to Construction Manager the following loose equipment:
 - 1) Keys for panelboards.
 - 2) Circuit-breaker handle locks.
 - 3) Spare fuses for main switchboard and disconnect switches.
 - 4) Spare fire alarm system devices, spare data network system components and cabling.
 - b. Obtain signed receipt for delivered loose equipment.
 2. Include receipt in operations and maintenance manual.
- D. Refer to Division 01 Specifications for additional information on Project closeout and cleanup.

1.15 OPERATION AND MAINTENANCE DATA

- A. Submit 3 complete copies of operating and maintenance manuals for each building to the Construction Manager 60 days prior to scheduled date of substantial completion. Noncompliance or incomplete submittal will be rejected and returned for resubmittal.
1. Photocopy paragraphs B and C below to be used a checklist for compliance with materials, format, and data.
 2. Once items are compiled, place a checkmark in the brackets for items included and strike through the items that do not apply.
 3. Submit checklist with operating and maintenance manuals.
- B. The operating and maintenance manuals shall consist of and will be reviewed for the following format and contents.
1. Binder:
 - a. Three-ring, plain black, vinyl binder free of vendor/contractor logos, etc.
 - b. Cover and spine (binder) identification including:
 - 1) Manual title: "OPERATION AND MAINTENANCE MANUAL."
 - 2) Owner.
 - 3) Project title.
 - 4) Owner's project number.
 - 5) Year of construction.
 - 6) Trade(s).
 - 7) Volume number and total number of volumes (e.g., Volume 1 of 2).
 2. Contents:
 - a. Project title page (enclosed in clear, transparent plastic sleeve) to match cover identification with at least one-third page blank for review stamp and comments.
 - b. Project directory page (enclosed in a clear transparent plastic sleeve) including name, address, and telephone number of:
 - 1) Owner.
 - 2) Architect.
 - 3) Engineer.
 - 4) Contractor.
 - 5) Subcontractor.
 - c. Table of contents (enclosed in a clear, transparent plastic sleeve) arranged to follow Specifications order (with format as list below):
 - 1) Warranty letter.
 - 2) Summary of scheduled maintenance.
 - 3) Replacement filter media and size summary.
 - 4) List of maintenance parts, repair/replacement parts, and recommended spare parts, including equipment name, part number, and suppliers (name, address, and phone number).
 - 5) Letters of certification for required system tests.
 - 6) Include on table of contents the following information for each product:

Spec. Section Number	Equipment Description	Supplying Company	Local Representative	Telephone Number
260500	Widgets	Acme Company	John Doe	555-1212
 - d. Submittals as indicated in "Submittals" Article of this Section, including:
 - 1) Approved copies of all submittals, including parts lists.
 - 2) Material safety data sheets for:
 - a) Firestopping.
 - 3) Installation, operating, and maintenance instructions.
 - 4) Wiring diagrams.
 - 5) Warranties.
 - 6) Test reports.

- C. Product Identification:
1. Provide indexed cardstock dividers between each submittal group.
 2. Arrange in an order corresponding to the original Project's Specifications.
 3. Where cataloged data covers more than one item, highlight applicable sections and identify corresponding equipment as marked on Drawings.
 4. Instructions shall include:
 - a. Time schedule for maintenance work (list each item of mechanical equipment requiring inspection, lubrication, or service) and description of the performance of such maintenance.
 - b. List of types of bearings for each piece of equipment with the type of lubricant required and frequency of lubrication.
 - c. Sequence of operating and/or flow diagrams for each of the systems, including emergency procedures.
 - d. Normal starting, operating, and shutdown procedures.

1.16 PROJECT RECORD DOCUMENTS

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Maintenance of Record Documents and Samples: Store record documents and samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Construction Manager's, Architect's, and/or Engineer's reference during normal working hours.
- C. Record Drawings:
1. Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - a. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - 1) Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - 2) Accurately record information in an acceptable drawing technique.
 - 3) Record data as soon as possible after obtaining it.
 - 4) Record and check the markup before enclosing concealed installations.
 - 5) Cross-reference record prints to corresponding archive photographic documentation.
 - b. Content: Types of items requiring marking include, but are not limited to, the following:
 - 1) Dimensional changes to Drawings.
 - 2) Revisions to details shown on Drawings.
 - 3) Locations and depths of underground utilities.
 - 4) Revisions to routing of piping and conduits.
 - 5) Revisions to electrical circuitry.
 - 6) Actual equipment locations.
 - 7) Locations of concealed internal utilities.
 - 8) Changes made by Change Order or Construction Change Directive.
 - 9) Changes made following Architect's written orders.
 - 10) Details not on the original Contract Drawings.
 - 11) Field records for variable and concealed conditions.

- 12) Record information on the Work that is shown only schematically.
 - c. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 - d. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 - e. Mark important additional information that was either shown schematically or omitted from original Drawings.
 - f. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
2. Submittals: Comply with the following:
- a. Submit Record Drawings as follows:
 - 1) Initial Submittal:
 - a) Submit paper-copy of marked-up record prints to Engineer for review. Submit a copy of each drawing, whether or not changes and additional information were recorded.
 - b) Engineer will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - 2) Final Submittal:
 - a) At the end of Project and after incorporating Engineer's review comments, submit paper-copy of final marked-up record prints and PDF electronic files of scanned record prints on a digital video disk recordable (DVD-R) to Construction Manager. Print each drawing, whether or not changes and additional information were recorded.
 - b. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
 - 1) Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include the following identification on cover sheets.
 - 2) PDFs: Organize into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification (i.e., Drawing Number). Include the following identification on DVD-R.
 - 3) Identification: As follows:
 - a) Project name.
 - b) Date.
 - c) Designation "PROJECT RECORD DRAWINGS."
 - d) Name of Architect.
 - e) Name of Contractor.
- D. Record Specifications: Comply with the following:
1. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
 - a. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - b. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 - c. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 - d. Note related Change Orders, record Product Data, and record Drawings where applicable.

2. Submittal: Submit paper copy of Record Specifications, including addenda and contract modifications, and scanned PDF electronic file(s) of marked-up paper copy of Specifications on DVD-R to Construction Manager. Identification shall be as stated hereinbefore for Record Drawings.
- E. Refer to Division 01 Specifications.

1.17 DEMONSTRATION AND TRAINING

- A. Owner's designated operating personnel shall be instructed in the care and operation of the systems in accordance with manufacturer's instructions and as indicated in these Specifications.
- B. Coordinate instruction schedule with Owner's operations. Notify Owner's personnel in advance of training. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.
- D. Training shall include, but not be limited to, the following systems:
 1. Main building fire alarm system,
 2. Athletic field lighting system and wireless control system.

1.18 WORK RELATED TO ASBESTOS AND WORK IN ASBESTOS-CONTAMINATED AREAS

- A. Portions of the existing mechanical systems and general construction are believed to be insulated or constructed with asbestos-containing materials.
- B. Asbestos-containing materials have reportedly contaminated portions of the crawlspace and ceiling plenum.
- C. Do not disturb such materials.
- D. Where work is unavoidable in contaminated areas, employ or subcontract the services of an "Allied Trade Certified Mechanic" (ATCM) to perform the work of this Division.
- E. It is understood that a separate contract has been, or will be, issued for the abatement of portions of the asbestos-containing materials.

PART 2 - PRODUCTS

2.1 TEMPORARY LIGHT AND POWER FOR CONSTRUCTION

- A. LED Fixtures:
 1. Low bay industrial type LED source with lamp guard.
 2. Rated 90 watts, 12,400 lumens, 120/277 volts.
 3. Available Product: Baron/Tracelite "EHB" series.
- B. Wire and receptacles: As specified in Division 26 Section "Wiring Devices."
- C. Outlet Boxes:
 1. Utility type, weatherproof.
 2. Available Manufacturer: Red Dot with weatherproof.
- D. Panelboards:
 1. Load-center type, rain tight.

2. Rating: 208Y/120 volts, 3-phase, 4-wire, ampere as required.
 3. Breakers: As required, GFI throughout.
 4. Manufacturers:
 - a. General Electric.
 - b. Eaton.
 - c. Square D.
- E. Disconnect Switches:
1. Rain tight, general duty, 250-V ac, 3-pole, fusible, size as required.
 2. Manufacturers:
 - a. General Electric.
 - b. Eaton.
 - c. Square D.
- F. Wireway:
1. Rain tight, size as required.
 2. Manufacturers:
 - a. General Electric.
 - b. Square D.
 - c. Keystone.

2.2 PENETRATION FIRESTOPPING

- A. Available Manufacturers:
1. A/D Fire Protection Systems Inc.
 2. Grace Construction Products.
 3. Hilti, Inc.
 4. Johns Manville.
 5. Nelson Firestop Products.
 6. NUCO Inc.
 7. Passive Fire Protection Partners.
 8. RectorSeal Corporation.
 9. Specified Technologies Inc.
 10. 3M Fire Protection Products.
 11. Tremco, Inc.; Tremco Fire Protection Systems Group.
 12. USG Corporation.
- B. Provide penetration firestopping materials that are compatible with one another, substrates, and penetrating items if any.
- C. Penetrations in Fire-Resistance-Rated Walls and Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
1. F-Rating at Fire-Resistance-Rated Walls: Not less than that of construction penetrated.
 2. F-Rating at Horizontal Assemblies: At least 1 hour, but not less than that of construction penetrated.
- D. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.

PART 3 - EXECUTION

3.1 TEMPORARY LIGHT AND POWER FOR CONSTRUCTION

- A. Provide and maintain temporary light and power as specified and as required by the NEC and OSHA.
- B. Relocate temporary work as may be required to avoid delaying work of other trades.

- C. Install suitable temporary lighting to provide a minimum of 5 foot candles at all locations within the buildings.
- D. Install a reasonable number of convenience receptacles to provide power for hand tools and other construction equipment. Locate so that any part of the buildings may be reached with a 100' extension cord.
- E. Remove all temporary panels, switches, wiring, etc., upon completion of Project.
- F. Special Services:
 - 1. Each trade wishing to use special circuitry for its power tools, etc., shall make the necessary arrangements with this Division's Contractor and pay all costs.
 - 2. Each trade shall provide its own extension cords.

3.2 PENETRATION FIRESTOPPING

- A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

END OF SECTION

SECTION 26 00 15

EARTH MOVING FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Excavating and backfilling for structures.
 - 2. Excavating and backfilling for utility trenches.
 - 3. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures.
 - 4. Final grading, together with placement and preparation of topsoil for lawns and planting.

1.2 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
 - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.
- C. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- D. Excavation: Removal of material encountered above subgrade elevations.
- E. Fill: Soil materials used to raise existing grades.
- F. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- G. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- H. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.3 SUBMITTALS

- A. Not required.

1.4 QUALITY ASSURANCE

- A. Pre-excavation Conference: Conduct conference at Project site to comply with requirements in Division 1 Specifications.
- B. Codes and Standards: Perform excavation work in compliance with applicable requirements of authorities having jurisdiction.
- C. Testing and inspection service: Refer to Division 1 for requirements.

1.5 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated.
 - 1. Notify Architect not less than seven days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Architect's written permission.
 - 3. Contact utility-locator service for area where Project is located before excavating.
- B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: ASTM D 2487 Soil Classification Groups GW, GP, GM, SW, SP, and SM, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Sand: ASTM C 33; fine aggregate, natural, or manufactured sand.
- E. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GRASS SEED

- A. Provide fresh, clean new-crop seed complying with tolerance for purity and germination established by Official Seed Analysts of North America.
- B. Seed Mixture: 25% Creeping Red Fescue; 40% Kentucky Bluegrass Blend; 35% Fine-Textured Endophytic Perennial Ryegrass.
- C. Percentages of Germination and Purity:

NAME	PURITY	GERMINATION
Creeping Red Fescue	97	85
Kentucky Bluegrass Blend	95	85
Perennial Ryegrass	98	90

- D. Packaging: Supply seed in manufacturer=s sealed containers. Labels on containers shall show a certified analysis of percentages of purity and germination.

- E. Fertilizer: Standard-quality commercial carrier of plant food elements containing nitrogen, phosphoric acid, and potash in the ratio of 1:2:1. Packaged in the manufacturer=s standard containers weighing not over 100 pounds in each with name of material, net weight of concrete, and manufacturer=s name and guaranteed analysis appearing on each container. Material that has become caked or otherwise damaged will be rejected.
- F. Mulch: Shall be stalks of straw, free from noxious weeds.

2.3 ASPHALT-AGGREGATE MIXTURE

- A. For patching to match existing pavement, provide asphalt-aggregate mixture as follows:
 - 1. NYSDOT Item 401-1:
 - a. Base material: Type 3.
 - b. Topping: Type 7.

2.4 DRAINAGE FABRIC

- A. Non-woven 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.

2.5 SEPARATION FABRIC

- A. 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.

2.6 ACCESSORIES

- A. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
 - 1. Red: Electric.
 - 2. Orange: Telephone and other communications.

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. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 31 Section(s).

- C. Protect and maintain erosion and sedimentation controls, which are specified in Division 31 Section(s), during earthwork operations.
- D. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials, as necessary.
- E. 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.

3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, 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 ground water away from excavations. Maintain until dewatering is no longer required.

3.3 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
 - 2. Remove rock to lines and grades indicated to permit installation of permanent construction:

3.4 EXCAVATION FOR STRUCTURES

- A. Excavate to a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 - 1. Excavation for Electrical Utility Structures: Excavate to a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

3.5 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated depths and elevations.
 - 1. Excavate trenches to uniform widths to provide ample working area and a 12" minimum clearance on each side of conduit.
 - 2. Excavate trenches to depth to allow installation of top of conduit below frost line and/or as indicated on Contract Documents.
 - 3. Excavate trenches 6" deeper than bottom of conduit elevation to allow for bedding course.
- B. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of conduit. Shape subgrade to provide continuous support for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

3.6 SUBGRADE INSPECTION

- A. Notify Architect when excavations have reached required subgrade.
- B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

3.7 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.
- B. Dispose of excess excavated soil materials not acceptable for use as backfill or fill.

3.8 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 - 2. Surveying locations of underground utilities for Record Documents.
 - 3. Testing and inspecting underground utilities.
 - 4. Removing concrete formwork.
 - 5. Removing trash and debris.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.9 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms when indicated. Shape bedding course to provide continuous support for joints, fittings, and bodies of conduits.
- C. Place and compact initial backfill, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the conduit.
- D. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- E. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.10 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory soil material.
 - 2. Under walks and pavements, use satisfactory soil material.
 - 3. Under steps and ramps, use engineered fill.
 - 4. Under building slabs, use engineered fill.
 - 5. Under footings and foundations, use engineered fill.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.11 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
 - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
 - 2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
 - 3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
 - 4. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

3.12 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross-sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
 - 3. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - a. Lawn or Unpaved areas: Plus or minus 1 inch.
 - b. Walks: Plus or minus 1 inch.
 - c. Pavements: Plus or minus ½ inch.
- B. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.13 CUTTING AND PATCHING

- A. Where required, cut paved areas perpendicular to surface and in straight lines.
- B. Replace asphalt areas, walks, etc., with materials specified or to match existing construction and in a manner acceptable to and as accepted by the Architect.

3.14 PREPARATION FOR PLANTING LAWNS

- A. Fine-grade lawn areas to smooth, even surface with loose, uniformly fine texture. Roll, rake, and drag lawn areas; remove ridges; fill depressions, as required to meet finish grades. Limit fine grading to areas that can be planted immediately after grading.
- B. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting lawns. Do not create a muddy soil condition.
- C. Restore lawn areas to specified condition, if eroded or otherwise disturbed, after fine grading and prior to planting.

3.15 SEEDING NEW LAWNS

- A. Do not use wet seed or seed that is moldy or otherwise damaged in transit or storage.
- B. Sow seed using a spreader or seeding machine. Do not seed when wind velocity exceeds 5 miles per hour. Distribute seed evenly over entire area by sowing equal quantity in 2 directions at right angles to each other.
- C. Sow not less than the quantity of seed specified or scheduled.
- D. Rake seed lightly into top 1/8" of soil, roll lightly, and water with a fine spray.
- E. Protect seeded areas against erosion by spreading straw mulch after completion of seeding operations. Spread uniformly to form a continuous blanket not less than 1-1/2" loose measurement over seeded areas.

3.16 RECONDITIONING EXISTING LAWNS DAMAGED BY CONSTRUCTION WORK

- A. Recondition existing lawn areas damaged by Contractor=s operations including storage of materials and equipment and movement of vehicles. Also recondition existing lawn areas where minor regrading is required.
- B. Provide seed as specified for new lawns, and as required, to provide a satisfactory reconditioned lawn.
- C. Provide new topsoil, as required, to fill low spots and meet new finish grades.
- D. Cultivate bare and compacted areas thoroughly to provide a satisfactory planting bed.
- E. Remove diseased and unsatisfactory lawn areas; do not bury into soil. Remove topsoil containing foreign materials resulting from Contractor=s operations, including oil drippings, stone, gravel, and other loose building materials.
- F. When substantial lawn remains but is thin, mow, rake, aerate if compacted, fill low spots, remove humps, cultivate soil, and seed. Remove weeds before seeding, or if extensive, apply selective chemical weed killers as required. Apply a seedbed mulch to maintain moist condition.
- G. Water newly planted lawn areas, and keep moist until new grass is established.

3.17 MAINTENANCE

- A. Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn, or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.18 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.19 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.
 - 1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Electrical equipment coordination and installation.
 - 2. Sleeves for raceways and cables.
 - 3. Sleeve seals.
 - 4. Grout.
 - 5. Common electrical installation requirements.

1.2 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.3 SUBMITTALS

- A. Product Data: For sleeve seals.

1.4 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for conduit installed at required slope.
 - 4. So connecting raceways and cables will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
3. Pressure Plates: Plastic. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

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

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.

- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials.
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 26 Section "General Requirements for Electrical."

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
 - 3. Variable-frequency motor controller (VFC) cables and connectors.
- B. Related Sections include the following:
 - 1. Division 26 Section "Raceways and Boxes for Electrical Systems."

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Manufacturers:
 - 1. American Insulated Wire Corp.; a Leviton Company.
 - 2. General Cable Corporation.
 - 3. Southwire Company.
- B. Copper Conductors: Comply with NEMA WC 70.
- C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN.

2.2 CONNECTORS, SPLICES, AND TERMINATIONS

- A. Available Product/Available Manufacturers:
 - 1. As listed below.
- B. Splices and Conductors:
 - 1. Splices:
 - a. No. 10 AWG and smaller: Buchanan Splice Caps, Ideal Wire Nuts, 3M Scotchlock #2.
 - b. No. 8 AWG and larger: Compression type, long barrel splice, copper body; Burndy "YS." Provide heat-shrink tubing insulation over each splice; tape.
- C. Terminations:
 - 1. Solid copper: Bare conductor under mechanical lugs.
 - 2. Stranded copper: Conductor direct where device or equipment has compression-type lugs. Use fork- or loop-type insulated terminations where equipment or device has screw terminations.
- D. Insulations:
 - 1. Molded composition caps: Burndy.
 - 2. Electrical tape: Scotch #33.

2.3 ARMOR-CLAD (AC) AND METAL-CLAD (MC) CABLES

- A. The use of AC- and MC-type cables is unacceptable.

2.4 VFC CABLES

- A. Basis-of-Design Product: Provide General Cable "CCW" series VFC cable or approved equal by one of the following:
 - 1. Belden.
 - 2. Service Wire Company.
- B. Description:
 - 1. Conductor: Class B, compressed, stranded bare copper in accordance with ASTM B 3 and B 8.
 - 2. Insulation: 90 deg C, wet/dry, flame-retardant, cross-linked polyethylene (FR-XLPE), UL-listed VW-1, 600-V-rated insulation, in accordance with ICEA S-95-658/NEMA WC70 and ICEA Method 4.
 - 3. Color Code: ICEA Method 4; individual black conductor with conductor number surface-printed on contrasting ink.
 - 4. Ground Conductors: Three symmetrically placed, stranded bare copper, in accordance with ASTM B 8 in contact with shield.
 - 5. Metallic Tape Shield: Overall 5-mil, annealed bare copper, tape shield with 50 percent minimum overlap.
 - 6. Overall Jacket: Lead-free, black, flame-retardant polyvinyl chloride (PVC) jacket. Low-temperature performance meets ASTM D 746, temperature at or below -40 deg C.
 - 7. A binder tape over the cable core.
 - 8. Sheath: Impervious, continuously welded, and corrugated aluminum alloy sheath in accordance with UL 1569 and UL 2225.

2.5 VFC CONNECTORS

- A. Products:
 - 1. Crouse Hinds "TMC" series armored glands.
 - 2. Remke Dome Caps "EMC" cable glands.
 - 3. Jacob "PERFECT Fix" cable glands.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-THWN, single conductors in raceway.
- B. Feeders: Type THHN-THWN, single conductors in raceway.
- C. Branch Circuits: Type THHN-THWN, single conductors in raceway.
- D. Class 1 Control Circuits: Type THHN-THWN, in raceway.

E. Class 2 Control Circuits: Type THHN-THWN, in raceway.

F. 600-V insulation for all wire.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

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 or raceway.

C. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

D. Wire

1. In raceways.

2. Wire shall be run in continuous lengths, without splices except at an accessible box or conduit fitting. Wire shall be kept on reels while being pulled and shall not be laid on the ground.

3. All control-circuit conductors shall be tagged with identification numbers at each location, such as, motor starters. All wires shall be labeled at both ends.

E. Circuiting:

1. Circuiting Arrangement:

a. Circuit arrangements indicated on Contract Drawings with regard to electrical loading and design concept shall be followed completely.

b. Actual circuit routing and grouping of circuits in common conduit shall be at the Contractor's option except where specifically noted how circuit routing shall be.

c. Each lighting circuit and each receptacle circuit shall have individual neutral conductors.

d. Circuit numbers labeling homeruns on Contract Drawings are intended for use at panels; may vary if necessary for load balance.

3. Lighting Circuits:

a. Switching control: As indicated on Contract Drawings.

b. Circuiting: Approximately as indicated, minor variations permitted.

4. Receptacle Circuits:

a. Circuiting: Approximately as indicated, minor variations permitted.

b. Special receptacle circuits as indicated on Contract Drawings.

5. Communication systems: Cable, cable terminations, etc., necessary to provide for functions specified.

6. Fire alarm systems: Cable, cable terminations, etc., necessary to provide for functions specified.

7. Power and Control Circuits (Built-In Equipment):

a. Provide power wiring and make all connections to disconnect switches, motor controllers, motors, etc., as indicated on Contract Drawings.

b. Verify exact location of all motors, controllers, control devices, etc., before roughing.

8. Wiring Diagrams:

a. Any wiring diagrams indicated on Contract Drawings for connecting equipment furnished by others are approximate and are for bidding purposes only.

b. Obtain wiring diagrams, certified correct for the job, from respective contractors for all equipment and systems furnished by them.

c. Install all work in accordance with certified wiring diagrams.

3.4 VFC CABLES

- A. Install VFC cables in accordance with manufacturer's cable installation guide.
- B. Install and maintain minimum cable-bend radius in accordance with NEC Article 300 and manufacturer's specifications.
- C. Provide 360-degree grounding contact at cable termination point. The shield and connector grounding system shall be pulled back in a 360-degree pattern.
- D. Provide VFC cable from the controller to the motor. Ground at the controller end.
- E. Provide cable connector glands as approved by the VFC cable manufacturer.

3.5 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.
- 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 6 inches of slack.

3.6 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
- 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.
- C. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment, plus the following special applications:
 - 1. Underground distribution grounding.
 - 2. Provide grounding system for incoming electric service in accordance with National Grid Power Company.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
 - 1. Ground rods.
 - 2. Grounding arrangements and connections for separately derived systems.
- C. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:
 - 1. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems.
 - a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
 - b. Include recommended testing intervals.
- D. Field quality-control reports.

1.3 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 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
- C. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 2 inches in cross-section, unless otherwise indicated; with insulators.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet in diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Unless otherwise indicated, install bare copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 30 inches below grade.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus on insulated spacers 1 inch, minimum, from wall 6 inches above finished floor, unless otherwise indicated.
- E. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground busses.

3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Pad-Mounted Transformers and Switches: Install four ground rods and ground ring around the pad. Ground pad-mounted equipment and non-current-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

3.4 EQUIPMENT GROUNDING

- A. Install insulated green equipment grounding conductors with all feeders and branch circuits.
- B. Air-Duct Equipment Circuits: Install insulated green equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- C. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, 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.
- D. Poles Supporting Outdoor Lighting Fixtures: Install grounding rod and a separate insulated equipment grounding conductor at each pole in addition to grounding conductor installed with branch-circuit conductors.

3.5 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 12 inches below finished floor or final grade, unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade. Make connections without exposing steel or damaging coating, if any.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations.
- D. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install 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, street side ahead of any fittings, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
 1. After installing grounding system but before permanent electrical circuits have 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. Make tests at ground rods before any conductors are connected.
 - a. Perform tests by fall-of-potential method according to IEEE 81.
- B. Report measured ground resistances that exceed the following values:
 1. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms minimum. Verify and meet requirements of all electrical systems with utility company.
- C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.

1.2 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.3 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.
 - 2. J-hooks for communication cables.

1.4 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements as indicated.
- B. Coordinate installation of equipment supports and roof penetrations.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Manufacturers:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. Thomas & Betts Corporation.
 - e. Unistrut; Tyco International, Ltd.
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 3. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
 - 1. J-Hook-Type Supports:
 - a. Provide J-hook-type supports for communication cables above accessible corridor ceilings.
 - b. Galvanized, stamped steel cable support.

- c. Comply with ENSO 174-2 and meet ISO/IEC 14763-2, TOA 568-C, and TIA 569-C.
 - d. Provide 4-inch-diameter unit rated for 60-lb static load and 220-V, Cat. 6 conductors (70 percent fill).
 - e. Product: Erico "CAT HP" series J-hook with mounting hardware.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
- 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 2. Mechanical-Expansion Anchors: Insert-wedge type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Manufacturers:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 - 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 - 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 - 6. Toggle Bolts: All-steel springhead type.
 - 7. Hanger Rods: Threaded steel.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Strength of Support Assemblies: Select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 - 6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 - 7. To Light Steel: Sheet metal screws.
 - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 3.
- C. Anchor equipment to concrete base.
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

END OF SECTION

SECTION 26 05 33

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.2 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. FMC: Flexible metal conduit.
- D. IMC: Intermediate metal conduit.
- E. LFMC: Liquidtight flexible metal conduit.
- F. RNC: Rigid nonmetallic conduit.

1.3 SUBMITTALS

- A. Product Data: For raceways, surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details.
 - 1. Submit floor plans to scale for proposed conduits in or under floor slab construction.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Manufacturers:
 - 1. Allied Tube & Conduit.
 - 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 3. Maverick Tube Corporation.
 - 4. O-Z Gedney.
 - 5. Wheatland Tube Company.
- B. Rigid Steel Conduit:
 - 1. ANSI C80.1.
 - 2. Hot-dipped galvanized steel.
 - 3. Fittings:

- a. Galvanized steel, threaded couplings, locknut, and insulated throat bushings.
- C. IMC:
 - 1. ANSI C80.6.
 - 2. Hot-dipped galvanized steel.
 - 3. Fittings:
 - a. Galvanized steel, threaded couplings, locknut, and insulated throat bushings.
- D. EMT:
 - 1. ANSI C80.3.
 - 2. Electrogalvanized steel.
 - 3. Couplings and Box Connectors:
 - a. General usage: Galvanized steel, setscrew type with insulated throat. Die cast is not allowed.
 - b. Wet and damp locations: Rain-tight and concrete-tight, compression type with steel compression nut with insulated throat.
- E. FMC:
 - 1. Galvanized steel.
 - 2. Conduit Connectors:
 - a. Galvanized steel, setscrew type with insulated throat. UL-approved as grounding type.
- F. LFMC:
 - 1. Flexible steel conduit with PVC jacket.
 - 2. Galvanized steel with liquid-tight and dust-tight jacket.
 - 3. Connectors:
 - a. Similar to FMC except provide with rated use with lighttight flexible conduit.
- G. Fittings for Conduit (Including all Types and Flexible and Liquid-tight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
- H. Conduit Fittings for Wire Pulling:
 - 1. Cast metal, lacquer protective coating.
 - 2. Covers: Galvanized sheet steel, blank, attached by two screws or dog devices.

2.2 NONMETALLIC CONDUIT AND TUBING

- A. Manufacturers:
 - 1. CANTEX Inc.
 - 2. CertainTeed Corp.; Pipe & Plastics Group.
 - 3. Lamson & Sessions; Carlon Electrical Products.
 - 4. RACO; a Hubbell Company.
- B. RNC: NEMA TC 2, Type EPC-80-PVC, unless otherwise indicated.
- C. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.

2.3 METAL WIREWAYS

- A. Manufacturers:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman.
 - 3. Square D; Schneider Electric.

- B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.
- C. 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.
- D. Wireway Covers: Hinged type.
- E. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

- A. Basis-of-Design Product: Provide Wiremold #700 series for Type A and Wiremold #V4000 series for Type B or approved equal by one of the following:
 - 1. Panduit.
 - 2. Hubbell.
- B. Surface Metal Raceways:
 - 1. Type A:
 - a. One piece consisting of base and cover, galvanized steel.
 - b. Size: 21/32-inch high, 3/4-inch wide, length as required.
 - c. Finish: Baked-enamel, ivory finish.
 - d. Fittings and boxes: Provide as required for complete installations to meet the intent of the Contract Drawings.
 - 2. Type B:
 - a. Two-section raceway of two pieces consisting of base and snap-on cover which snap on a common base. Galvanized steel with divider.
 - b. Size: 4-3/4 inches high, 1-3/4 inches deep, length as indicated on Contract Drawings.
 - c. Finish: Ivory.
 - d. Entrance End Fittings:
 - 1) Available Product: Wiremold #V4010A.
 - 2) Unless otherwise indicated, provide entrance end fitting at beginning of all lengths of two-section raceway. Provide power raceways and conductors as called for to power side of entrance end fitting. Provide one 1-1/4-inch and one 1-inch raceway for data/communications conductors to communications side of entrance end fitting. Extend data/communications raceway from entrance end fitting out to above accessible ceiling at corridor. Provide bushings on all conduits.
 - e. Fittings: Provide as required for complete installations indicated on Contract Drawings.
 - f. Provide fiberoptic "FO" sweep fittings or equal at all 90-degree transitions in surface raceways.
 - g. Devices:
 - 1) Device Mounting Plates: Wiremold #V4047 series.
 - 2) Duplex-Receptacle Cover Plate: Wiremold #V4047 series.
 - 3) Data-Jack Cover Plate: Wiremold CM-2 Series bracket.

2.5 BOXES, ENCLOSURES, AND CABINETS

- A. Outlet Boxes:
 - 1. Manufacturers:
 - a. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 - b. EGS/Appleton Electric.
 - c. Hoffman.
 - d. Hubbell Incorporated.
 - e. O-Z/Gedney.

- f. RACO.
- g. Thomas & Betts Corporation.
- 2. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- 3. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- 4. Interior Wall/Ceiling:
 - a. Galvanized sheet steel for exposed and opened ceilings.
 - b. Galvanized sheet steel for recessed wall, equipped with appropriate plaster rings.
 - c. Covers:
 - 1) As required by device or equipment mounted on box.
 - 2) Blank covers for boxes with no device or equipment mounted on box.
- 5. Multi-Service Wall Box:
 - a. Basis-of-Design Product: Provide Wiremold "Wallsource Box" or approved equal from the manufacturers listed in paragraph A.1 above.
 - b. The box and all system components shall be UL-listed in full compliance with the standard for 514A and 514C; steel shall be galvanized with a minimum wall thickness of .063 throughout. Back-feed brackets shall be .050 minimum steel with a gray or ivory, suitable for field painting. The device mounting bracket shall be molded from color-matching, UL-approved resins.
 - c. The box shall include the box, dividers, and mounting brackets. The dimensions of each shall be a minimum of 32 cubic inches per gang and shall be manufactured of 16-gauge-minimum-thick steel. The box shall accommodate standard power and communication devices.
 - d. The box shall have knockouts located on top and bottom, 2-1/4 inches from the face to accommodate combinations of 1/2-, 3/4-, and 1-inch trade-size conduits. Boxes of 4 or 6 gangs shall have knockouts to accommodate 1-1/2-inch trade-size conduit.
 - e. The box shall have a separate ground terminal provided for each gang.
 - f. The box shall adjust for a flush installation with the finished wall. There shall be positive stops for surface mounting to 1/2-, 5/8-, 1-, and 1-1/4-inch-thick wallboard. Adjusting screws are located outside the box for adjustment prior to installation.
 - g. The self-leveling device mounting bracket shall accommodate standard power devices, connectivity inserts, and Wiremold #5507 series faceplates. A mounting bracket designed to accept other manufacturer's devices shall be available. The bracket accommodates up to 6 power devices or 18 communications inserts. All Wiremold standard faceplates, mounting brackets, and trim rings shall be color-matched.
 - h. The depth of the box shall accommodate a 1-1/4-inch cable-bend radius, which meets or exceeds the specifications for fiberoptic and Category 6 cabling and TIA/EIA 569A requirements for communications pathways. A 1-inch controlled-radius storage loop shall be available.
 - i. Device cover plates in the following configurations must be available:
 - 1) Duplex device cover plates.
 - 2) Single 1.40- and 1.59-inch-diameter receptacle cover plates.
 - 3) Switch plates.
 - 4) GFCI cover plates.
 - 5) Surge-receptacle cover plates.
 - 6) Other rectangular-faced plates.
 - j. Single-gang cover plates shall be of modular design and shall be compatible with Wiremold wire and cable management systems.
 - k. The box manufacturer will provide a complete line of connectivity outlets and modular multi-media inserts for voice, data, video, audio, etc., with faceplates and bezels to facilitate mounting.

- l. A complete line of preprinted station- and port-identification labels, snap-in icon buttons, and write-on station-identification labels shall be available.
 - m. A support bracket for mounting on 16-inch center studs must be provided for boxes consisting of more than 2 gangs.
 - n. Dividers must be removable without any tools.
- B. Interior Floor Boxes:
- 1. General: Galvanized stamped steel.
 - a. Basis-of-Design Product: Provide Wiremold #880 series or approved equal by one of the following:
 - 1) Appleton.
 - 2) Hubbell.
 - b. One-, two-, or three-gang configurations; deep versions.
 - c. 1-3/4 inches of pre-pour adjustment and 1/2 inch of post-pour adjustment.
 - d. Minimum three 1/2-inch and five 3/4-inch conduit knockout locations.
 - e. Cover-plate flanges: Brass, combination carpet-and-tile flange.
 - f. Cover plates: Brass device cover plates with flip lids. Cover plate to match device configuration indicated on Contract Drawings.
 - g. Provide all accessories and mounting brackets required to accept devices.
 - 2. Type "A": Galvanized stamped steel, high-capacity multi-compartment box.
 - a. Basis-of-Design Product: Provide Wiremold #RFB9 series or approved equal by one of the following:
 - 1) FSR.
 - 2) Hubbell.
 - b. Size: 14-15/16 inches L x 12-1/8 inches W x 4-1/8 inches H.
 - c. Three independent wiring compartments to allow up to one 6-gang compartment and three 1-gang compartments.
 - d. Conduit Knockouts:
 - 1) 6-gang: Three 1 inch and 1-1/4 inches.
 - 2) 1 gang: 3/4 inch and 1 inch.
 - 3) Combination: Two 1 inch and 1-1/4 inches.
 - e. External pre-pour adjustment: Maximum 1-7/8 inches.
 - f. Internal mounting brackets accept standard-size device cover plates. Cover plate to match device configuration indicated on Contract Drawings.
 - g. Cover: Cast-aluminum trim ring for flush tile or carpet. Two 15/16- x 6-3/8-inch access doors fold in under lid for cable egress.
 - h. Provide all accessories and mounting brackets required to accept devices. Provide two duplex receptacles and three wired (Category 6), RJ45 data jacks at each floor box. Provide additional telephone/communications jacks (wired) as called for in the Contract Documents.
- C. Poke-through assembly–surface-mounted: The poke-through device shall be made up of an insert, junction-box assembly, activation service head, and face plates.
- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Wiremold #RC91/RC92 series or approved equal by one of the following:
 - a. Hubbell.
 - b. Thomas & Betts.
 - 2. Insert:
 - a. The insert body shall have the necessary channels to provide complete separation of power and communication services. There shall be a 1-inch trade-size conduit channel with an integral divider for running both power and communication cabling. The body will also consist of an intumescent firestop material to maintain the fire rating of the floor slab. The intumescent material will be held securely in place in the insert body

and shall not have to be adjusted to maintain the fire rating of the unit and the floor slab. Junction box (when used for power only) offers 30-cubic-inch volume capacity. When used for power and communication, the junction box offers 25-cubic-inch capacity in the power compartment. Insert shall have a spring steel-retaining ring that will hold the poke-through device in the floor slab without additional fasteners. Insert shall also accept conduit connectors to accommodate extensions for deeper concrete slab depths.

- b. Activation service head: The activation service head shall be 0.125-inch clear anodized aluminum. Service heads shall come in double-width configurations. Service heads shall attach directly to the insert body. A gasket is attached to the underside of the service heads to maintain scrub-water tightness. Service heads shall also provide a barrier to complete isolation of power and communication cables throughout the poke-through assembly. Face plates shall be .086-inch clear anodized aluminum.
 - c. Double-width service head shall be 9-1/4 inches W x 4-5/8 inches L x 2-5/8 inches H. Double-width service-volume capacity shall be 81 cubic inches without the divider in place and 27 cubic inches for the power compartment only. Face-plate dimensions shall be 9 inches L x 2-1/2 inches H. Provide two 20-Amp duplex receptacles and four wired, RJ45 (Category 6) jacks at each outlet.
- D. Pull and Junction Boxes: NEMA OS 1.
- 1. Manufacturers:
 - a. Appleton.
 - b. Steel City.
 - c. RACO.
 - 2. Galvanized or baked-enamel sheet steel.
 - 3. Covers: Flat.
 - a. Attach with a minimum of four screws.
 - b. Galvanized or baked-enamel steel to match box.
- E. Exterior Boxes:
- 1. Manufacturers:
 - a. Crouse-Hinds.
 - b. Appleton.
 - c. Hubbell.
 - 2. Cast metal, watertight, NEMA 4.
 - 3. Cover: As required by device, watertight.
- F. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
- 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
- G. Cabinets:
- 1. NEMA 250, Type 1, galvanized-steel box.
 - 2. Hinged door in front cover with flush latch and concealed hinge.

2.6 SLEEVES FOR RACEWAYS

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Exterior wall below grade: Cast-iron pipe sleeves, cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.
- D. Fire-Rated Wireways:
 - 1. Basis-of-Design Product: Specified Technologies Inc. "EZ-PATH Fire Rated Pathway" or approved equal.
 - 2. Cables passing through fire-rated floors or walls shall pass through a fire-rated wiring pathway that contains an intumescent insert material that adjusts automatically to cable additions or subtractions.
 - 3. Pathway shall have an F rating equal to the rating of the barrier in which the pathway is installed.
 - 4. Pathway shall be capable of allowing a 0% to 100% visual fill of cables.
 - 5. Pathway shall be of a sufficient size to accommodate the quantity and size of electrical wires and data cables required.
 - 6. Pathway to be provided with steel wall plates, allowing for single or multiple devices to be ganged together.

2.7 SLEEVE SEALS

- A. Manufacturers:
 - 1. Advance Products & Systems, Inc.
 - 2. Metraflex Co.
 - 3. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
 - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 2. Pressure Plates: Plastic. Include two for each sealing element.
 - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
 - 1. Exposed Conduit: Rigid steel conduit.
 - 2. Concealed Conduit, Aboveground: EMT.
 - 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 4. Boxes and Enclosures, Aboveground: NEMA 250, Type 4.
- B. Comply with the following indoor applications, unless otherwise indicated:
 - 1. Exposed at all locations: Rigid steel conduit or intermediate metallic conduit. Includes raceways in the following locations:
 - 2. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 - 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 - 4. Damp or Wet Locations: Rigid steel conduit.
 - 5. Electric Rooms, Mechanical and Boiler Rooms, and Gymnasiums: Rigid steel conduit or IMC.
 - 6. School Technology and Shop Areas: Rigid steel conduit or IMC.
 - 7. Conduit Installed Within Floor Slabs:
 - a. Maximum size shall be 1 inch.
 - b. Rigid steel conduit.
 - c. RNC, Type EPC-80-PVC.

- d. Provide rigid steel, threaded conduit stub-up elbows.
 - e. Submit proposed conduit layout within slab to Architect for review. Do not install any conduits in or under slab without written approval from the Architect and Structural Engineer.
8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, nonmetallic in damp or wet locations.
- C. Minimum Raceway Size: 1/2-inch is intended unless specifically noted otherwise.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
- 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings.

3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Conceal conduit and EMT within finished walls, ceilings, unless otherwise indicated.
- F. Raceways Embedded in Slabs:
- 1. Run conduit, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Change from RNC, Type EPC-80-PVC, to rigid steel conduit before rising above the floor.
- G. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- H. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- I. 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. Provide bushings at all ends of conduit.
- J. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semi-recessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
- 1. Use LFMC in damp or wet locations subject to severe physical damage.
 - 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- K. Wall Outlet Boxes:
- 1. Where required for outlet facility.
 - 2. Flush, recessed wherever possible, except where specifically noted, surface-mounted.
 - 3. Support securely from building construction, not from raceway.
 - 4. Seal all unused openings.

- L. Pull and Junction Boxes:
 - 1. Where indicated on Contract Drawings or as required (by Code) except none permitted in finished rooms.
 - 2. Must remain accessible. None allowed above ceilings unless ceiling is lay-in type.
 - 3. Support from building construction, not from raceway.
 - 4. Seal all unused openings.

3.3 INSTALLATION OF SURFACE RACEWAY

- A. Install securely to wall or ceiling parallel with ceiling, wall, or floor lines.
- B. Use concealed fastening devices secured at maximum 2-foot intervals.
- C. Provide raceways, conductors, outlets, fittings, and faceplates as called for and required to install a complete system.

3.4 INSTALLATION OF FLOOR BOXES/OUTLETS

- A. Coordinate installation of floor boxes/outlets with existing/new structure, and install in accordance with manufacturer's instructions.
- B. All floor installations shall be fully inspected and accepted by Owner's Representative prior to any pouring of concrete.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- B. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- C. Rectangular Sleeve Minimum Metal Thickness:
 - 1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
 - 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint.
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 26 Section "General Requirements for Electrical."

- K. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground, exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 26 Section "General Requirements for Electrical."

3.8 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 - 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.

END OF SECTION

SECTION 26 05 43

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks.
 - 2. In-ground handholes and pull boxes.
 - 3. Manholes.

1.2 DEFINITION

- A. RNC: Rigid nonmetallic conduit.
- B. PVC: Polyvinyl chloride.

1.3 SUBMITTALS

- A. Product Data: For the following:
 - 1. Duct-bank materials, including separators and miscellaneous components.
 - 2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
 - 3. Accessories for manholes, handholes, pull boxes, and other utility structures.
 - 4. Warning tape.
- B. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:
 - 1. Duct entry provisions, including locations and duct sizes.
 - 2. Frame and cover design and manhole frame support rings.
 - 3. Grounding details.
- C. Shop Drawings for Factory-Fabricated Handholes and Pull Boxes Other Than Precast Concrete: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:
 - 1. Duct entry provisions, including locations and duct sizes.
 - 2. Cover design.
 - 3. Grounding details.
- D. Product Certificates: For concrete and steel used in precast concrete, as required by ASTM C 858.
- E. Field quality-control reports.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.
- B. Store precast concrete and other factory-fabricated underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.
- C. Lift and support precast concrete units only at designated lifting or supporting points.

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Architect or Owner's Representative no fewer than seven days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Architect's written permission.

1.6 COORDINATION

- A. Coordinate layout and installation of ducts, manholes, handholes, and pull boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.
- B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and pull boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

PART 2 - PRODUCTS

2.1 CONDUIT

- A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.
- B. PVC: NEMA TC 2, Type EPC-40-PVC and Type EPC-80-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES

- A. Manufacturers:
 - 1. Cantex, Inc.
 - 2. Condux International, Inc.
 - 3. Lamson & Sessions; Carlon Electrical Products.
- B. Underground Plastic Utilities Duct: NEMA TC 6 & 8, Type DB-80-PVC (direct buried) and Type DB-40-PVC (concrete encased), ASTM F 512, with matching fittings by the same manufacturer as the duct, complying with NEMA TC 9.
- C. Duct Accessories:
 - 1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
 - 2. Warning Tape: Underground-line warning tape specified in Division 26 Section "Identification for Electrical Systems."

2.3 HANDHOLES AND PULL BOXES OTHER THAN PRECAST CONCRETE

- A. Description: Comply with SCTE 77.
 - 1. Color: Gray.
 - 2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
 - 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating of UL Tier 22, non-deliberate loading by heavy vehicles.
 - 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

5. Cover Legend: Molded lettering, "ELECTRIC," "TELEPHONE," and as indicated for each service.
 6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installations in enclosure walls.
 7. Size: 36 inches wide by 36 inches long by 30 inches deep, clear inside dimensions.
 8. Provide interior barrier/divided at divided handholes.
- B. Polymer Concrete Handholes and Pull Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.
1. Manufacturers:
 - a. Armorcast Products Company.
 - b. CDR Systems Corporation.
 - c. Quazite by Strongwell.

2.4 PRECAST MANHOLES

- A. Basis-of-Design Product: Provide Lakelands #MH466 series or approved equal by one of the following:
1. Fort Miller Co.
 2. Kistner Concrete Products.
 3. P&S Concrete Products.
 4. Lakeland Co.
- B. General:
1. Wall construction: 6 inches thick, steel-reinforced.
 2. Precast, steel-reinforced concrete with one-piece cover with 40-inch-diameter opening, sump hole in bottom for pump, offset elevations for conduit openings for incoming and outgoing conduits. Provide pulling iron at bottom of wall, opposite each opening and knockout panels as called for.
 3. Size: 4 feet wide, 6 feet long, 4 feet deep, inside dimensions.
 4. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
 - a. Type and size shall match fittings to duct or conduit to be terminated.
 - b. Fittings shall align with elevations of approaching ducts and be located near interior corners of manholes to facilitate racking of cable.
 5. Meet all requirements of National Grid.
- C. Manhole Cover:
1. Basis-of-Design Product: Provide East Jordan Ironworks #1833 or approved equal by Neenah.
 2. Provide heavy-duty cast pull-box frame and cover. Provide frame with 36-inch-diameter opening, 47-inch round flange (overall diameter and 8 inches deep from top of cover to bottom of flange).
 3. Provide heavy-duty cover with full gasketing, watertight seal, and drop lift handle. Cast label pull-box cover "Electric." Provide with 3/8-inch stainless-steel bolts to secure cover to flange.
- D. Concrete Knockout Panels: 1-1/2 to 2 inches thick, for future conduit entrance and sleeve for ground rod.
- E. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

PART 3 - EXECUTION

3.1 UNDERGROUND DUCT APPLICATION

- A. Ducts for Electrical Cables Over 600 V: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.
- B. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.
- C. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-80-PVC, in direct-buried duct bank, unless otherwise indicated.
- D. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.

3.2 UNDERGROUND ENCLOSURE APPLICATION

- A. Handholes and Pull boxes for 600 V and Less, Including Telephone, Communications, and Data Wiring:
 - 1. Provide polymer concrete, SCTE 77, Tier 15 structural load rating.
- B. Manholes: Precast concrete.
 - 1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.
 - 2. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.

3.3 EARTHWORK

- A. Excavation and Backfill: Comply with Division 31 Section "Site Earthwork" and Division 26 Section "Earth Moving for Electrical," but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 32 Section "Seeded and Sodded Lawns."
- D. Cut and patch existing pavement in the path of underground ducts and utility structures according to Division 01 Section "Cutting and Patching."

3.4 DUCT INSTALLATION

- A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.
- B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations, unless otherwise indicated. Coordinate with NYSEG.

- C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.
- D. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Division 26 Section "Common Work Results for Electrical."
- E. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.
- F. Pulling Cord: Install 100-lbf-test nylon cord in ducts, including spares.
- G. Concrete-Encased Ducts: Support ducts on duct separators.
 - 1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
 - 2. Concreting Sequence: Pour each run of envelope between terminations in one continuous operation.
 - a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
 - b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into concrete on both sides of joint near corners of envelope.
 - 3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
 - 4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
 - 5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
 - 6. Minimum Space between Ducts: 3 inches between ducts and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and signal ducts.
 - 7. Depth: Install top of duct bank at least 36 inches below finished grade.
 - 8. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
 - b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.
 - 9. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches of the

centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

3.5 INSTALLATION OF CONCRETE MANHOLES AND PULL BOXES

- A. Precast Concrete Manhole Installation:
 - 1. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
 - 2. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

3.6 INSTALLATION OF HANDHOLES AND PULL BOXES OTHER THAN PRECAST CONCRETE

- A. Install handholes and pull boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: Set so cover surface will be flush with finished grade. Set covers of other handholes 1 inch above finished grade.

3.7 GROUNDING

- A. Ground underground ducts and utility structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
 - 1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
 - 2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
 - 3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Correct deficiencies and retest as specified above to demonstrate compliance.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Identification for conductors and communication and control cable.
 - 2. Underground-line warning tape.
 - 3. Warning labels and signs.
 - 4. Panelboard and equipment identification labels.

1.2 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.

1.3 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape.
- B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.2 UNDERGROUND-LINE WARNING TAPE

- A. Description: Permanent, bright-colored, continuous-printed, polyethylene 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 shall indicate type of underground line.

2.3 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

- C. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER—ELECTRICAL SHOCK HAZARD—EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING—OSHA REGULATION—AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.4 PANELBOARD AND EQUIPMENT IDENTIFICATION LABELS

- A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 1/2inch.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source and circuit number.
- B. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- C. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
 - 1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
 - 2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
- D. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual.
 - 1. Labeling Instructions:
 - a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where 2 lines of text are required, use labels 2 inches high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - 2. Equipment to Be Labeled:
 - a. Panelboards, electrical cabinets, and enclosures.
 - b. Access doors and panels for concealed electrical items.
 - c. Electrical switchgear and switchboards.
 - d. Transformers.
 - e. Emergency system boxes and enclosures.
 - f. Disconnect switches.
 - g. Enclosed circuit breakers.
 - h. Motor starters.
 - i. Push-button stations.
 - j. Power transfer equipment.
 - k. Contactors.
 - l. Power-generating units.
 - m. Voice and data cable terminal equipment.

- n. Master clock and program equipment.
- o. Fire-alarm control panel and annunciators.
- p. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
- q. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.

3.2 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - 1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
- F. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.

END OF SECTION

SECTION 26 09 23

LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Occupancy and vacancy sensors.
 - 2. Momentary contact switch.
 - 3. Wall-mounted occupancy sensors.
 - 4. Wall-mounted vacancy sensors.
- B. Related Requirements:
 - 1. Section 26 27 26 "Wiring Devices" for wall-box dimmers and manual light switches.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Show installation details for the following:
 - a. Occupancy sensors.
 - b. Vacancy sensors.
 - 2. Interconnection diagrams showing field-installed wiring.
 - 3. Include diagrams for power, signal, and control wiring.
- C. Manufacturer's warranty information.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of lighting control device to include in operation and maintenance manuals.

1.4 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Faulty operation of lighting control devices.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 OCCUPANCY AND VACANCY SENSORS

- A. High-Definition Vacancy/Presence Sensor with Dimming:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Steinel "IR Quattro DIM-24" or comparable product by one of the following:
 - a. Philips Lighting Controls.
 - b. Wattstopper.
 - 2. Ceiling-mounted, low-voltage, high-definition with 4 integral pyroelectric detectors, passive infrared presence detector; detect occupants in coverage area by their heat and movement. Provide this type of occupancy vacancy sensor at all locations unless indicated otherwise.
 - 3. Mounting: 4-inch square box.

4. Voltage: 18- to 24-V dc/V ac
 5. Load Rating:
 - a. Control Output (Blue): 1 A at 30-V ac/V dc.
 - b. 1- to 10-V dimming output (purple & gray): 100 mA, maximum 50 (1-10 V electronic dimming ballasts/drivers).
 6. Settings:
 - a. Time Delay Setting:
 - 1) Dimming: 1- to 10-V electronic dimming ballasts.
 - 2) Control Output: 30 seconds to 30 minutes.
 - 3) Pulse Mode: Approximately 2 seconds.
 - 4) IQ Mode: Automatic adjustment to the usage profile.
 - b. Light Level Setting: 1 - 100 fc, Force OFF photo control factory setting, turns lights off when sufficient daylight is present.
 - c. Dip Switch Settings:
 - 1) Automatic mode (AUTO) and Manual ON mode (MAN).
 - 2) Momentary and maintained switch option.
 - 3) 'ON' only and 'ON' & 'OFF' manual switching.
 - 4) Constant light level DIM control option measures the level of daylight and activates sufficient artificial light to achieve the required level of light intensity.
 7. COM-Link: Grouping for up to 10 sensors.
 8. Real-time motion indicator LED: Visible from the front of unit while in test mode.
 9. Connection: Power pack with 0- to 10-V dimming capability.
 10. Test Mode: Dip switch setting or programming remote.
 11. Operating Temperature: 32 deg F to 104 deg F.
 12. Installation Height: 8 to 32 feet.
 13. Coverage at 9 feet: 360-degree square mechanically scalable detection zones.
 - a. Presence: Maximum 25.5 feet by 25.5 feet or 650.25 sf.
 - b. Radially: Maximum 25.5 feet by 25.5 feet or 650.25 sf.
 - c. Tangentially: Maximum 65.5 feet by 65.5 feet or 4,290.25 sf.
 14. High-Performance Lens Design: 13 detection levels, 4800 switching zones.
 15. Dimensions: 4.72 by 4.72 by 2.83 inches.
 16. Warranty Length: 5 years.
 17. Certifications: C-UL-US Listed, RoHS compliant, UL 2043 Plenum Rated, CA Energy Code compliant.
 18. Color: White.
 19. Grouping: Up to 10 sensors.
 20. Accessories:
 - a. RC 8 Programming Remote.
 - b. Smart Remote.
 21. General Requirements for Sensors:
 - a. Ceiling-mounted, solid-state vacancy sensors.
 - b. Passive infrared technology.
 - c. Separate power pack with 0- to 10-V dimming capability.
 - d. Hardwired connection to momentary contact switch to provide ON-OFF and dimming capabilities.
- B. Ultrasonic Control Occupancy Sensor, Type "u":
1. Basis-of-Design Product: Subject to compliance with requirements, provide Steinel "US Quattro COM1-24" or comparable product by one of the following:
 - a. Philips Lighting Controls.
 - b. Wattstopper.
 2. Mounting: 4-inch square box.
 3. Voltage: 18- to 24-V dc/V ac, 50/60 Hz.
 4. Load Rating:
 - a. Control Output: 1 A at 30-V ac/V dc.
 5. Settings:
 - a. Time Delay Setting:

- 1) Control Output: 30 seconds to 30 minutes.
 - 2) Pulse Mode: Approximately 2 seconds 'ON' and 8 seconds 'OFF.'
 - 3) IQ Mode: Automatic adjustment to the usage profile.
 - b. Light Level Setting: 1-100 fc, turns lights off when sufficient daylight is present.
 - c. Dip Switch Settings:
 - 1) Automatic mode (AUTO) and Manual ON mode (MAN).
 - 2) Momentary and maintained switch option.
 - 3) 'ON' only and 'ON' & 'OFF' manual switching.
 6. COM-Link: Grouping for up to 10 sensors.
 7. Real-time Motion Indicator LED: Visible from the front of unit while in test mode.
 8. Connection: Power pack.
 9. Test Mode: Dip switch setting or programming remote.
 10. Operating Temperature: 32 deg F to 104 deg F.
 11. Coverage at 9 feet:
 - a. Presence: Maximum 20 feet by 20 feet or 400 sf.
 - b. Radially and Tangentially: Maximum 32 feet by 32 feet or 1,000 sf.
 12. Dimensions: 4.72 by 4.72 by 2.68 inches.
 13. Warranty Length: 5 years.
 14. Certifications: C-UL-US Listed, RoHS compliant, UL 2043 Plenum Rated.
 15. Color: White.
 16. Accessories:
 - a. RC 3 Service Remote.
 - b. RC 8 Programming Remote.
 - c. Smart Remote.
 - d. RC 4 User Remote.
 - e. WGC Wire Guard Cage.
- C. Ultrasonic Control for Occupancy Sensors at Corridors, Type "c":
1. Basis-of-Design Product: Subject to compliance with requirements, provide Steinel "US Hallway COM1-24" or comparable product by one of the following:
 - a. Philips Lighting Controls.
 - b. Wattstopper.
 2. Ceiling-mounted, low-voltage, ultrasonic occupancy detector.
 3. Mounting: 4-inch square box.
 4. Voltage: 18- to 24-V dc/V ac, 50/60 Hz.
 5. Load Rating:
 - a. Control Output: 1 A at 30-V ac/V dc.
 6. Settings:
 - a. Time Delay Setting:
 - 1) Control Output: 30 seconds to 30 minutes.
 - 2) Pulse Mode: Approximately 2 seconds 'ON' and 8 seconds 'OFF.'
 - 3) IQ Mode: Automatic adjustment to the usage profile.
 - b. Light Level Setting: 1-100 fc, turns lights off when sufficient daylight is present.
 - c. Dip Switch Settings:
 - 1) Automatic mode (AUTO) and Manual ON mode (MAN).
 - 2) Momentary and maintained switch option.
 - 3) 'ON' only and 'ON' & 'OFF' manual switching.
 - d. Program occupancy sensors at corridors to automatically turn lights on when coverage area is occupied and turn them off when unoccupied; with a time-delay setting adjusted to 30 minutes.
 7. COM-Link: Grouping for up to 10 sensors.
 8. Real-Time Motion Indicator LED: Visible from the front of unit while in test mode.
 9. Connection: Power pack.
 10. Test Mode: Dip switch setting or programming remote.
 11. Operating Temperature: 32 deg F to 104 deg F.

12. Coverage at 9 feet: Maximum 6.5 feet by 65 feet or 422.5 sf.
13. Dimensions: 4.72 by 4.72 by 2.87 inches.
14. Warranty Length: 5 years.
15. Certifications: C-UL-US Listed, RoHS compliant, UL 2043 Plenum Rated, CA Energy Code compliant.
16. Color: White.
17. Unless noted otherwise, program Type "C" occupancy sensors to reduce lighting to 50 percent only.

D. Dual-Technology Occupancy Sensor (Type "DT"):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Steinel "DT Quattro COM1-24" or comparable product by one of the following:
 - a. Philips Lighting Controls.
 - b. Wattstopper.
2. Ceiling-mounted, low-voltage, passive infrared and ultrasonic occupancy detector.
3. Mounting: 4-inch square box.
4. Voltage: 18- to 24-V dc/V ac, 50/60 Hz.
5. Load Rating:
 - a. Control Output: 1 A at 30-V ac/V dc.
6. Sensing Technology: Passive infrared (PIR), single pyro, 11 detecting levels, 520 switching zones, ultrasonic 40 kHz.
7. Settings:
 - a. Time Delay Setting:
 - 1) Control Output: 30 seconds to 30 minutes.
 - 2) Pulse Mode: Approximately 2 seconds 'ON' and 8 seconds 'OFF.'
 - 3) IQ Mode: Automatic adjustment to the usage profile.
 - b. Light Level Setting: 1-100 fc, turns lights off when sufficient daylight is present.
 - c. Dip Switch Settings:
 - 1) Automatic mode (AUTO) and Manual ON mode (MAN).
 - 2) Momentary and maintained switch option.
 - 3) 'ON' only and 'ON' & 'OFF' manual switching.
 - d. Program dual-technology occupancy sensors to automatically turn lights on when coverage area is occupied and turn them off when unoccupied, with a time-delay setting adjusted to 30 minutes.
8. COM-Link: Grouping for up to 10 sensors.
9. Real-Time Motion Indicator LED: Visible from the front of unit while in test mode.
10. Connection: Power pack.
11. Test Mode: Dip switch setting or programming remote.
12. Operating Temperature: 32 deg F to 104 deg F.
13. Ultrasonic Coverage at 9 feet:
 - a. Presence: Maximum 20 feet by 20 feet or 400sf.
 - b. Radially and Tangentially: Maximum 32 feet by 32 feet or 1,000 sq. ft.
14. PIR Detection Zones:
 - a. Presence: Maximum 10 feet by 10 feet or 100sf.
 - b. Radially: Maximum 13 feet by 13 feet.
 - c. Tangentially: Maximum 26 feet by 26 feet.
15. Dimensions: 4.72 by 4.72 by 2.68 inches.
16. Warranty Length: 5 years.
17. Certifications: C-UL-US Listed, RoHS compliant, UL 2043 Plenum Rated, CA Energy Code compliant.
18. Color: White.

E. High-Bay Occupancy Sensor, Type "d":

1. Basis-of-Design Product: Steinel #HBS-300 series or comparable product by one of the following:
 - a. Wattstopper.

- b. Hubbell.
- 2. Ceiling-surface-mounted passive infrared sensor.
- 3. 360 degrees of coverage up to 45-ft mounting height with 40-ft-diameter coverage at 20-ft mounting height.
- 4. Three highly sensitive pyroelectric detectors and a multi-segmented lens with protective wire guard (by manufacturer) at all locations.
- 5. Secure sensors with surface steel boxes and heavy-gauge steel wire guards to bottom of steel.

2.2 MOMENTARY CONTACT SWITCH

- A. Basis-of-Design Product: Steinel "MCS" series or approved equal by one of the following:
 - 1. Wattstopper.
 - 2. Philips.
- B. Provide momentary contact switch for on-off and dimming control and interface to power packs and sensors with dimming, Type "v" vacancy/presence detector with dimming power pack.
- C. Momentary contact switch shall be:
 - 1. Single pole, single throw (SPST).
 - 2. Standard Decora style.
 - 3. Rated at 3 amperes, 24-V ac/dc or higher if required to meet system requirements.
 - 4. Polycarbonate frame and rocker with heavy-gauge steel strap, back and side wiring terminals, Industrial grade rated.

2.3 WALL-MOUNTED OCCUPANCY SENSORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Steinel "IR WLS 1" or comparable product by one of the following:
 - 1. Philips Lighting Controls.
 - 2. Wattstopper.
- B. Line-Voltage, Single-Relay, Passive Infrared (PIR), Wall Switch Occupancy Sensor Intended to Control Lighting in Areas.
 - 1. Voltage: 120/230/277-V ac, 50/60 Hz.
 - 2. Mounting: Single-gang, NEMA-style switch box (standard switch box) and decorator-style wall plate by others.
 - 3. Load Rating:
 - a. Tungsten, magnetic or electronic ballast: 0-800 watts at 120/230/277-V ac, 50/60 Hz.
 - b. LED electronic ballasts: 0-600 watts at 120/230/277 VAC, 50/60 Hz.
 - c. 1/6 hp at 120/230/277-V ac, 50/60 Hz.
 - 4. Settings:
 - a. Light Level Setting: 8-200 fc keeps lights OFF when sufficient daylight is present.
 - b. Dip Switch Settings:
 - 1) Manual ON or Automatic ON option.
 - 2) Walk Through Mode: Switch the load OFF in 3 minutes if no additional detection occurs after the first 30 seconds.
 - 3) Audible Alert: Provides an audible warning that the load will shut-OFF in 10 seconds unless additional motion is detected
 - 4) Visible Alert: Provides a momentary OFF/ON blink, warning that the load will shut OFF in 10 seconds unless additional motion is detected
 - c. Time Setting: IQ/Test, 5, 15, 30 minutes.

- 1) IQ Mode: Dynamically adjusts the 'ON' time delay by learning individual room occupancy.
- 2) Test Mode: Time delay defaults to 5 seconds and all loads are switched on/off by motion detection. After 5 minutes the time delay reverts to the IQ Mode.
- d. Service Mode: Deactivates the automated functions of the sensor and the load is only manually controlled using the ON/OFF button.
5. Switching: Performed at, or close to the zero-cross of the AC waveform in order to improve relay performance
6. Switch Link: Allows communication of sensors for 2-way, 3-way, and 4-way switching.
7. Real-time motion indicator LED: Visible from the front of unit while in test mode.
8. Operating Temperature: 32 deg F to 104 deg F.
9. PIR Coverage at 4-ft Mounting Height: 180-degree coverage pattern.
 - a. Minor Motion: Maximum 21 by 18 feet or 378 sf.
 - b. Radially: Maximum 24 feet or 904 sf.
 - c. Tangentially: Maximum 54 feet or 4,500 sf.
10. Dimensions: 4.13 by 1.74 by 1.78 inches.
11. Warranty: 5 years.
12. Certifications: C-UL-US Listed; RoHS compliant; California Compliant.

2.4 ULTRASONIC WALL-MOUNTED VACANCY SENSORS WITH 0- TO 10-V DIMMING

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Steinel "US VS DIM" or comparable product by one of the following:
 1. Philips Lighting Controls.
 2. Wattstopper.
- B. Line-Voltage, Single-Relay, Ultrasonic Wall Switch Vacancy (Manual "On" Only) Sensor:
 1. Voltage: 120/230/277 VAC, 50/60 Hz.
 2. Mounting: Single-gang, NEMA-style switch box (standard switch box); provide decorator-style wall plate.
 3. Load Rating:
 - a. LED Electronic Drivers: 0-600 watts at 120/230/277-V ac, 50/60 Hz.
 - b. 1/6 hp at 120/230/277-V ac, 50/60 Hz.
 4. 0- to 10-V dimming, 40-kHz, ultrasonic, wall switch, vacancy sensor.
 5. 180-degree coverage pattern.
 6. Reach Setting: Adjustable from 25 percent to 100 percent.
 7. Dip Switch Settings:
 - a. Walk-Through Mode: Switch the load OFF in 3 minutes if no additional detection occurs after the first 30 seconds.
 - b. Audible Alert: Provides an audible warning that the load will shut-OFF in 10 seconds unless additional motion is detected
 - c. Visible Alert: Provides a momentary OFF/ON blink, warning that the load will shut OFF in 10 seconds unless additional motion is detected
 8. Time Setting: IQ/Test, 5, 15, 30 minutes.
 - a. IQ Mode: Dynamically adjusts the 'ON' time delay by learning individual room occupancy.
 - b. Test Mode: Time delay defaults to 5 seconds and all loads are switched on/off by motion detection. After 5 minutes the time delay reverts to the IQ Mode.
 9. Service Mode: Deactivates the automated functions of the sensor and the load is only manually controlled using the ON/OFF button.
 10. Switching: Performed at, or close to the zero-cross of the AC waveform in order to improve relay performance
 11. Switch Link: Allows communication of sensors for 2-way, 3-way, and 4-way switching.
 12. Real-Time Motion Indicator LED: Visible from the front of unit while in test mode.
 13. Operating Temperature: 32 deg F to 104 deg F.

14. Ultrasonic Coverage at 4-ft Mounting Height: 180-degree coverage pattern.
 - a. Minor Motion: Maximum 18 by 12 feet or 216 sf.
 - b. Radially: Maximum 24 feet or 904 sf.
 - c. Tangentially: Maximum 24 feet or 904 sf.
15. Dimensions: 4.13 by 1.74 by 1.78 inches.
16. Warranty: 5 years.
17. Certifications: C-UL-US Listed; RoHS compliant; California Compliant.

2.5 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SENSOR INSTALLATION

- A. Comply with NECA 1.
- B. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- C. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.3 CONTACTOR INSTALLATION

- A. Comply with NECA 1.
- B. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.4 WIRING INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Comply with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.
- C. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.5 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 26 05 53 "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Lighting control devices will be considered defective if they do not pass tests and inspections.
- C. Perform the following field tests and inspections:
 - 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 operation of each lighting control device, and adjust time delays.

3.7 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 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. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
 - 3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

END OF SECTION

SECTION 26 20 00

LOW-VOLTAGE ELECTRICAL TRANSMISSIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes the following:
 - 1. Distribution panels.
 - 2. Panelboards.
 - 3. Transformers and transformer power center.
 - 4. Transient voltage suppression devices.
 - 5. Switching and protective equipment.
 - 6. Grounding.

- B. Related Sections:
 - 1. Division 26 Section "Wiring Devices."
 - 2. Division 26 Section "Grounding and Bonding for Electrical Systems."

1.2 SUBMITTALS

- A. Product Data for the following:
 - 1. Panelboards.
 - 2. Transformers.
 - 3. Transient voltage suppression devices.
 - 4. Switching and protective equipment.
 - 5. Grounding.

- B. Shop Drawings: For distribution equipment and related components.
 - 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 panelboards and overcurrent protective devices.
 - d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 2. Wiring Diagrams: Power, signal, and control wiring.

- C. Qualification Data: For testing agency.

- D. Field quality-control test reports including the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

- E. Provide certification stating that equipment has been installed in accordance with manufacturer's requirements.

- F. Operating and Maintenance Data:
 - 1. For distribution equipment and components to include in emergency, operation, and maintenance manuals.
 - a. Routine maintenance requirements for switchboards and all installed components.
 - b. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

- c. Time-current curves, including selectable ranges for each type of overcurrent protective device.
2. Panelboards.
3. Transformers.
4. Transient voltage suppression devices.
5. Motor starters.

1.3 MATERIAL MAINTENANCE SUBMITTALS

- A. Spare Fuses: Furnish a minimum of one set of three for each size indicated on the Contract Drawings.

1.4 QUALITY ASSURANCE

- A. Equipment shall be designed, manufactured, assembled, and tested in accordance with the latest revisions of applicable published ANSI, NEMA, and IEEE standards and with the requirements of UL and NEC.
- B. Provide field supervision and service by competent and qualified representative of the manufacturer, who is regularly engaged in working with this type of equipment.

PART 2 - PRODUCTS

2.1 DISTRIBUTION PANELBOARDS

- A. Basis-of-Design Product: Provide Square D "I-line" or approved equal by one of the following:
 1. Siemens.
 2. Cutler-Hammer.
- B. General Requirements:
 1. All components designed, tested, and assembled in accordance with the latest applicable UL, IEEE, NEMA, and NEC standards.
 2. Indoor type, dead front.
 3. Equipment shipped as determined by Contractor for this Division and as required for installation and access into building.
- C. Rating:
 1. Voltage: 480/277 volts or 208/120 volts, 3-phase, 4-wire, 60 Hz.
 2. Ampere: As indicated on Drawing.
- D. Construction and Requirements:
 1. Minimum 16-gauge, galvanized, code-grade sheet steel cabinet.
 2. Gutters on four sides, adequate for wiring required; sized to latest NEC.
 3. Standard gray, enamel finish.
 4. Enclosure, NEMA Class 1 for mounting against wall.
 5. Bus:
 - a. Copper: Provide adequate lugs for connecting incoming conductors.
 - b. Provide 3-phase bus, 1 isolated neutral bus, and 1 isolated ground bus.
 - c. Braced to withstand 25,000-Amp, RMS symmetrical fault or short-circuit current.
- E. Distribution Section:
 1. Bus: Provide full rated phase and neutral busses.
 2. Branch Feeder Switches:
 - a. Current-limiting circuit breakers with rating as indicated on Drawings.
 - b. Rating: 480 volts, 35 kAIC, ampere unless otherwise indicated.
 - c. Lugs sized for feeders shown on distribution diagram.

2.2 PANELBOARDS

- A. Basis-of-Design Product: Provide Square D #NQOD/NF series or approved equal by one of the following:
1. Siemens.
 2. Cutler-Hammer.
- B. Rating:
1. Voltage: As shown on panelboard schedule.
 2. Main circuit breaker: Three-pole, size and voltage as indicated on panelboard schedule.
 3. Mains: Three-phase, four-wire, size as shown on panelboard schedule with lugs adequate for feeder size indicated. Cable terminations rated 75 deg C minimum.
 4. Lugs: Sized for feeder indicated on power distribution diagram. Suitable for copper conductors. Rated 75 deg C minimum.
- C. Branch-Circuit Breakers:
1. Construction: Molded-case Bakelite, "SW" label.
 2. Switch Action: Toggle, quick-make-and-break switch.
 3. Overload Action: Thermal magnetic, positive indication of tripped condition.
 4. Trip Elements: Permanent; non-interchangeable; two-pole and three-pole breakers shall have internal common trip.
 5. Ampere Rating: 15-200 Amp as scheduled on power distribution diagram; rating permanently engraved on handle.
 6. Voltage Rating: 120- or 277-V ac for 1 pole, 120/240- or 277/480-V ac for 1 pole and 2 poles, 240- or 480-V ac for 3 poles.
 7. Interrupting Capacity: As called for on Drawings; 22,000 AIC unless otherwise indicated.
 8. Assembly: Bolt-on.
 9. Conductor terminations rated 75 deg C minimum.
 10. Common internal trip, no tie handles.
- D. Construction:
1. Code-gauge galvanized steel cabinet, rigidly formed, code-size gutters, dead-front construction when trim is removed.
 2. Depth of Cabinet: 6" maximum.
 3. Mains, neutral bar, and branch circuits as shown on power distribution diagram; metal barrier, forming dead-front construction. Provide full copper bussing.
 4. Panels scheduled for double main lugs and/or subfeed lugs shall be provided with suitable gutter space on sides and bottom.
 5. Smooth steel door, rigidly formed, directory, minimum projection chrome-plated latch lock; all locks keyed alike, directory with protecting glass or plastic cover.
 6. Hinged, smooth steel trim shall be attached to cabinet with screws, with hinged door-in-door construction. Flush- or surface-mounted as indicated on panelboard schedule. Door-in-door framing shall secure hinged door with screws. Lift-and-hinge-type opening is not acceptable.
 7. All exposed surfaces shall be finished in gray, baked enamel.
 8. Spaces: All spaces in all panels shall be equipped with necessary box and hardware for future insertion of breakers.
 9. Load centers are not acceptable.

2.3 DRY-TYPE TRANSFORMERS

- A. Manufacturers:
1. Siemens.
 2. Square D.
 3. Cutler-Hammer.

- B. General:
1. Ventilated, NEMA 250, Type 2,
 2. Finish color: Gray.
 3. Windings: Aluminum.
 4. All transformers shall be NEMA TP-1 and K-4 rated.
- C. Insulation Class:
1. 30 kVA and Above:
 - a. 220 deg C insulation system.
 - b. 115 temperature rise above a 40 deg C ambient under full load conditions.
 - c. Capable to carry a continuous 15 percent overload without exceeding 150 deg C rise above ambient.
 2. Under 30 kVA:
 - a. 185 deg C insulation system.
 - b. 30 deg C hot spot, 40 deg C ambient.
- D. Sound Ratings: Minimum of 3 dBA less than NEMA ST20 Standard sound levels when factory-tested according to IEEE C57.12.91.
- E. Electrical Characteristics:
1. Primary: 480 volts, 3-phase, delta.
 2. Secondary: 208/120 volts, wye.
 3. Secondary Taps: Two 2-1/2% taps above rated voltage and two 2-1/2% taps below rated voltage.
- F. Lugs: Ground lug on frame and strap to ground the core assembly to frame of enclosure, ground shield, all internal components.
- G. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.
1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
 2. Include special terminal for grounding the shield.
 3. Shield Effectiveness:
 - a. Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.
 - b. Common-Mode Noise Attenuation: Minus 120 dBA minimum at 0.5 to 1.5 kHz; minus 65 dBA minimum at 1.5 to 100 kHz.
 - c. Normal-Mode Noise Attenuation: Minus 52 dBA minimum at 1.5 to 10 kHz.
- H. K-Factor Rating: Transformers to be K-factor rated and comply with UL 1561 requirements for non-sinusoidal load current-handling capability to the degree defined by designated K-factor of K-4.
1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
 2. Indicate value of K-factor on transformer nameplate.
 3. Neutral conductor sized at 2 times rate-phase current.
- I. Buck-Boost Transformers:
1. Description: Self-cooled, two-winding dry type, rated for continuous duty and with wiring terminals suitable for connection as autotransformer. Transformers shall comply with NEMA ST 1 and shall be listed and labeled as complying with UL 506 or UL 1561.
 2. Enclosure: Ventilated, NEMA 250, Type 2.
 3. Finish color: Gray.

- J. Control and Signal Transformers:
 - 1. Description: Self-cooled, two-winding dry type, rated for continuous duty, complying with NEMA ST 1, and listed and labeled as complying with UL 506.
 - 2. Ratings: Continuous duty. If rating is not indicated, provide at least 50 percent spare capacity above connected peak load.

- K. Transformer Power Center:
 - 1. Basis-of-Design Product: Provide Siemens "Sentron Power Center Series" or approved equal by:
 - a. Square D "Mini-Power Zone Transformer/Centers."
 - 2. Provide prewired, combination of the following:
 - a. Primary circuit-breaker disconnect.
 - b. Dry-type shielded transformer.
 - c. Secondary circuit-breaker disconnect.
 - d. Secondary power panelboard.
 - 3. Power-center enclosures shall be rated NEMA 3R and UL-listed.
 - 4. 180 deg C, UL insulation system with a 115 deg C temperature-rise transformer with copper windings.
 - 5. Power center units to be electrostatically shielded with 2 to 5 percent full-capacity, below-normal (FCBN) taps.
 - 6. Power panel assembly to accommodate bolt-on circuit breakers in configurations as called for/scheduled. Power center assembly to include primary and secondary main circuit breakers.
 - 7. Provide power center rated 15KVA with 480V, single phase primary and 240/120V. Single phase secondary with distribution section as called for.

2.4 TRANSIENT VOLTAGE SUPPRESSION DEVICES

- A. Manufacturers:
 - 1. Siemens.
 - 2. Square D.
 - 3. Cutler-Hammer.
 - 4. Current Technology.

- B. General:
 - 1. High-Performance Suppression System: The unit shall include an engineered, solid-state, high-performance suppression system utilizing arrays of nonlinear, voltage-dependent, metal oxide varistors with similar operating characteristics. The suppression-system components shall optimally share surge currents in a seamless, low-stress manner ensuring maximum performance and proven reliability. The suppression system shall not utilize gas tubes, spark gaps, silicon avalanche diodes, or other components that might short or crowbar the line, thus leading to interruption of normal power flow to or system upset of connected loads.
 - 2. High-Frequency, Extended-Range Power Filter: The unit shall include a high-frequency, extended-range power filter and shall be UL 1283-listed as an electromagnetic interference filter. The filter shall reduce fast rise-time, high-frequency, error-producing transients and electrical line noise to harmless levels, thus eliminating disturbances that may lead to electronic-system upset.
 - 3. Internal Connections: All full-magnitude transient current shall be conducted utilizing low-impedance copper bus bar. No plug-in component modules or quick-disconnect terminals shall be used in surge current-carrying paths.
 - 4. Standard Enclosure: NEMA 4, fiberglass-reinforced polyester.
 - 5. Optional Open Frame: The unit shall be optionally available in an open-frame configuration to facilitate installation within a switchgear cubicle, electrical enclosure, or other barriered section. Open-frame space requirements include modular design with field-replaceable modules, sine-wave-tracking type with the following features and accessories:

- a. Fuses, rated at 200-kA interrupting capacity.
 - b. Fabricated using bolted compression lugs for internal wiring.
 - c. Integral disconnect switch.
 - d. Redundant suppression circuits.
 - e. Redundant replaceable modules.
 - f. Arrangement with copper bus bars and for bolted connected to phase buses, neutral bus, and ground bus.
 - g. LED indicator lights for power and protection status.
 - h. Audible alarm, with silencing switch, to indicate when protection has failed.
 - i. One set of dry contacts rated at 5 Amp and 250-V ac, for remote monitoring of protection status. Coordinate with building power monitoring and control system.
 - j. Surge-event operations counter.
 - k. Maximum continuous operating voltage: 115% of nominal voltage.
 - l. Operating frequency: 47 to 63 Hz.
6. Protection Modes: All protected modes are defined in accordance with NEMA LS-1-1992, paragraph 2.2.7. Following IEEE Standard 1100-1992, Section 9.11.2 recommendations. Wye-configured systems shall provide line-to-neutral, line-to-ground, line-to-line, and neutral-to-ground protection. Delta-configured systems shall provide line-to-line protection and line-to-ground protection.
- C. Unit Operating Voltage:
- 1. Type 1, Service Entrance: 480Y/277 or 208Y/120 volts, 3-phase, 4-wire.
 - 2. Type 2, Subdistribution: 480Y/277 or 208Y/120 volts, 3-phase, 4-wire.
 - 3. Type 3, Panelboard: 208Y/120 volts, 3-phase, 4-wire.

D. Rated Single-Pulse Surge Current Capacity:

Description	Rated, Single-Pulse Surge Current Capacity (in Amps)				
	L-N	L-G	N-G	L-L	Per Phase
Service Entrance, Type 1	200,000	200,000	200,000	200,000	400,000
Subdistribution, Type 2	100,000	100,000	100,000	100,000	200,000
Panelboard, Type 3	80,000	80,000	80,000	80,000	160,000

- E. UL 1449 (Second Edition), Suppressed Voltage Ratings:
- 1. Types 1, 2, and 3:
 - a. Line to neutral: 800 V at 480Y/277 V and 400 V at 208Y/120 V.
 - b. Line to ground: 1000 V at 480Y/277 V and 500 V at 208Y/120 V.
 - c. Neutral to ground: 800 V at 480Y/277 V and 500 V at 208Y/120 V.
- F. High-Frequency Attenuation:
- 1. Type 1: 53 dB at 50 kHz and 31 dB at 1 MHz.
 - 2. Type 2: 50 dB at 50 kHz and 33 dB at 1 MHz.
 - 3. Type 3: 47 dB at 50 kHz and 37 dB at 1 MHz.
- G. Overcurrent Protection:
- 1. Each suppression element shall be fused to ensure that the failure of a single component or the operation of a single fuse element remains isolated and does not render the entire mode, or product, deficient by more than the following percentages:
 - a. Type 1: <5%.
 - b. Type 2: <10%.
 - c. Type 3: <17%.
 - 2. For systems utilizing a hybrid technology, each element type shall be fused.
 - 3. Every current-carrying conductor associated with a component shall be fused to ensure that every fault is isolated at the point of the fault or at the component level.

4. Fusing shall be present in all modes, including neutral to ground.
5. All overcurrent/fault-current protection shall be UL-recognized as a standalone fuse.
6. All fusing must be UL-recognized and tested at 200 kAIC. Testing shall be inclusive of all available product voltages.
7. All fuses and overcurrent/fault-current-protection devices shall consist of self-arc-quenching, sand-encapsulated, UL-recognized fuse arrays. Each fuse shall be individually sealed in a manner that eliminates cross-arcing.
8. The device shall be capable of withstanding the full single-pulse surge current capacity for every mode without the operation or failure of overcurrent/fault-current protection or fuses.

2.5 SWITCHING AND PROTECTIVE EQUIPMENT

- A. Disconnect Switches:
 1. Manufacturers:
 - a. Square D
 - b. Cutler-Hammer
 - c. Siemens
 2. Type:
 - a. Quick make, quick break, fusible or non-fusible as noted.
 - b. Heavy duty, horsepower-rated.
 - c. Defeatable cover interlock.
 - d. Positive pad-locking in "OFF" position.
 - e. Auxiliary contact for elevator power disconnect; interconnection to elevator battery-operated lowering device.
 3. Rating:
 - a. 250 volts or 600 volts, as applicable.
 - b. Current-carrying capacity as indicated on Drawings or as required by motors.
 4. Poles: As required by load.
 5. Enclosure:
 - a. Indoors, dry areas: NEMA Type 1.
 - b. Indoors, wet areas: NEMA Type 4.
 - 1) Kitchen areas/equipment: NEMA 4, stainless steel.
 - c. Outdoors: NEMA Type 4.
- B. Fuses:
 1. Manufacturers:
 - a. Bussman.
 - b. Chase-Shawmut.
 - c. Littelfuse.
 2. All fuses shall bear the UL label for the classes specified herein.
 3. 600 Ampere or Less:
 - a. Rated 250/600 volts as required.
 - b. UL Class RK1 with time delay.
 - c. Fusible equipment shall have fuseholders equipped with Class R rejection clips.
 4. Above 600 Ampere:
 - a. Rated 600 volts or less.
 - b. UL Class L, current limiting, time delay.
 5. Ampere Ratings: As indicated on the Contract Drawings.
- C. Motor Starters:
 1. Manufacturers:
 - a. Square D.
 - b. Cutler-Hammer.
 - c. Siemens.

2. Manual:
 - a. Rating: 115/230 volts.
 - b. Size: As required by motor horsepower.
 - c. Poles: As required.
 - d. Operation: Single-throw on-off toggle handle.
 - e. Motor Protection: Thermal overload in each phase, interchangeable heater sized to motor current rating by Division 26 Contractor after motor has been installed.
 - f. Enclosure: Same as described for disconnect switches hereinbefore.
 - g. Accessories: Provide as indicated on Contract Drawings.
3. Magnetic:
 - a. Poles: Two or three as required.
 - b. Size: As required by motor horsepower.
 - c. Voltage: 250-V or 600-V ac contacts; 24- or 120-V ac coils through integral control transformer.
 - d. Motor protection: Thermal overload, interchangeable heaters sized to motor has been installed. Provide protection in each phase. Overload relay shall be of the manual-reset type.
 - e. Operation: Full-voltage starting, single speed, non-reversing.
 - f. Enclosure: Same as described for disconnect switches hereinbefore.
 - g. Accessories:
 - 1) Hand-off-auto switch in cover.
 - 2) Green pilot light in cover.
 - 3) Red pilot light in cover.
 - 4) Two normally open and two normally closed contacts.
4. Combination Magnetic: Switch-and-fuse type meeting all requirements specified for disconnect switches and magnetic motor starters hereinbefore.
5. Refer to Division 23 for variable-frequency drives.

D. Contactors:

1. Manufacturers:
 - a. Square D.
 - b. Cutler-Hammer.
 - c. Siemens.
2. Electrically operated, mechanically or electrically held as called for. Provide on-off switch in cover when indicated on Contract Drawings.
3. Contacts rated 250 or 600 volts, and current-carrying capability as indicated on Contract Drawings.
4. Coil rating: 120 volts, 60 Hz.
5. Poles as indicated on Contract Drawings.
6. Enclosure: Same as described for disconnect switches hereinbefore.

E. Relays:

1. Manufacturers:
 - a. Square D.
 - b. Cutler-Hammer.
2. Electrically operated, electrically held.
3. 1 pole, 20 Amp, normally open.
4. Contacts rated 250 or 600 volts.
5. Coil as required by control system.
6. Enclosure: Same as described for disconnect switches hereinbefore.

2.6 GROUNDING

A. Manufacturers:

1. Burndy.
2. O-Z Gedney.
3. Thomas and Betts.

- B. Insulated Conductors: Copper wire or cable insulated for 600 V.
- C. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4-inch diameter.
 - 4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 5. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 - 6. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- D. Grounding Bus: Rectangular bars of annealed copper, 1/4- x 2-inch cross-section, unless otherwise indicated; with insulators.
- E. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- F. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- G. Ground Rods: Copper-clad steel, sectional type; 3/4-inch diameter x 10-foot length.

PART 3 - EXECUTION

3.1 INSTALLATION--GENERAL

- A. Coordinate with installation of other equipment associated with the power distribution system.
- B. Miscellaneous bolts, washers, nuts, clips, lock washers, and small hardware made of silicon-bronze or equal rust-resistant material to make a complete installation.
- C. Complete installation shall be in accordance with equipment manufacturer's instructions, drawings, and recommendations.
- D. In the event of conflict, discrepancy, or difference between manufacturer's instructions and the Contract Documents, the more stringent requirements shall apply.
- E. Suitable equipment handling to unload, move, set in place, install, erect, and assemble the equipment.
- F. Comply with grounding requirements.
- G. Minimum working clearance, as described in NEC Article 110-16, for all electric equipment.
 - 1. Additional working or aisle clearance as required.
- H. Verify cable/lug sizes for terminations. When a feeder is sized larger than a lug, provide in-line splice to reduce conductor size to match equipment or breaker terminations.
- I. Unload, move, handle, set in place, install, erect, assemble, connect, test, and operate each item of electrical equipment.

3.2 DISTRIBUTION PANELBOARDS AND PANELBOARDS

- A. Verify each location at site before installing cabinet or conduit.
- B. Mount cabinet level and plumb, flush or surface as indicated on Contract Drawings.
- C. Install recessed cabinet flush with finished wall.
- D. Properly align panel in cabinet.
- E. Touch up scratches with matching paint.
- F. Provide five empty 3/4-inch conduit and one empty 1-1/2-inch conduit from panel to ceiling space for each flush-mounted panel. Arrange for future continuation.
- G. Provide channel support for surface-mounted panels. Provide channel support between wall and panel back box where installed against outside wall.
- H. Provide handle lock-on devices for breakers that supply circuits for the following items:
 - 1. Exit signs.
 - 2. Fire alarm system.
 - 3. Telephone system.
 - 4. Clock system.
 - 5. Temperature control panels.
 - 6. Paging system.
 - 7. Data network system.
- I. Connect branch-circuit wiring using the circuit numbers indicated on Contract Drawings.
- J. Provide engraved circuit-identification nameplates on panels with letters and numbers as indicated on Contract Drawings.
- K. Provide complete typewritten directory for each panel, with all room numbers and function positively identified for each individual branch circuit.
- L. Handwritten directory shall be provided until all circuits are connected and balanced. Then, install permanent typewritten directory. Do not mark circuit identification on the front or enclosure of panels or on other electric equipment.
- M. Provide engraved nameplate, white on red background, for those on emergency circuits.
- N. Provide engraved nameplate, white on black background, for those on normal circuits.

3.3 DRY-TYPE TRANSFORMERS AND TRANSFORMER POWER CENTERS

- A. Grounding: Provide grounding systems.
- B. Connections:
 - 1. Provide Belleville (spring-type) washers for copper-to-aluminum runout connections.
 - 2. Coat connection with oxide-inhibiting compound prior to attachment.
 - 3. Provide proper phasing.
- C. Mounting:
 - 1. Wall-mounted for 25 kVA, single phase and smaller; 15 kVA, 3-phase and smaller. Provide bracing.
 - 2. Floor-, trapeze-, or platform-mounted for indoor applications as indicated on Contract Drawings.

3. Provide vibration isolator devices for mounting transformers.
 4. Provide wall-mounted isolators rated for shear and tension loads.
 5. Maintain a minimum of 6 inches to the nearest wall for safety and proper ventilation.
 6. Loosen transformer shipping lock bolts.
 7. Anchor transformer to isolators and isolators to floor.
 8. Provide 4-inch-high concrete pad for each floor-mounted interior installation and exterior installation.
- D. Clearance: Provide minimum working clearances as described in NEC Article 110-16 plus additional clearance required for ventilation servicing, not less than 6 inches from walls.
- E. Identification:
1. Provide engraved lamincoid nameplate with 1/2-inch letters, indicating the following:
 - a. Transformer identifying numbers.
 - b. kVA.
 - c. Panel or load unit served.
 - d. System designation.
 2. Attach nameplate mechanically.
 3. Be sure manufacturer's nameplate is secured.

3.4 TRANSIENT VOLTAGE SUPPRESSION DEVICES

- A. Install devices at service entrance on load side, with ground lead bonded to service entrance ground.
- B. Install devices for panelboard and auxiliary panels with conductors or buses 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.
- C. Do not energize or connect service entrance equipment and panelboards to their sources until surge protection devices are installed and connected.
- D. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust equipment installation including connections. Report results in writing.
- E. Remove and replace malfunctioning units and retest as specified above.
- F. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transient voltage suppression devices.

3.5 SWITCHING AND PROTECTIVE EQUIPMENT

- A. Disconnect switches: Install at locations indicated on Contract Drawings and as required by code.
- B. Motor Starter, Contactors, Relays: Surface-mounted at locations indicated on Contract Drawings.
- C. Fuses:
 1. Motor fuses shall be sized in accordance with NEC and equipment manufacturer's instructions based on full-load motor nameplate rating. Provide label in each switch stating size and type of fuse.
 2. Replace all blown fuses up to final acceptance of job.

3.6 GROUNDING SYSTEM

- A. General:
1. Do not install bare copper bars, cables, and fittings in cinder fill or cover with soil containing cinders or other corrosive material.
 2. Install cables with enough slack to prevent breaking stresses.
 3. Provide rigid steel conduit or other suitable steel guards to protect grounding conductors subject to mechanical damage.
 4. Where rigid steel conduit protects ground cable, permanently and effectively ground steel conduit to enclosure and ground cable at each end of its length.
 5. Where grounding conductors pass through floor slabs or walls and are not encased in metal conduit, provide PVC, Schedule 80, nonmetallic conduit sleeve.
 6. The length, number, spacing, and location of ground rods shall be as indicated on Contract Drawings.
 7. The depth to which ground rods are driven shall be 12 inches below grade to top or to refusal.
 8. Provide bonding connections to all water pipes, including domestic water and sprinkler mains. Include water meter, dielectric break device, or other similar device bypass connections. Surface of the pipe at point of connection shall be thoroughly cleaned and brightened; immediately prior to actually making the connection, the contact surfaces shall be coated with oxide-inhibiting compound.
 9. Each equipment ground bus, ground pad, frame, and enclosure shall have surfaces a point of connection thoroughly cleaned and brightened just prior to actually making the connection. Touch up damaged painted surfaces.
 10. Splices in wire or cable grounding conductors are prohibited.
 11. All grounding shall be in strict accordance with NEC Article 250.
- B. Raceway Systems:
1. Metal supports, brackets, for the raceway system, panels, switches, boxes, starters, and controls, which are not rigidly secure to and in contact with the raceway system or which are subject to vibration and loosening, shall be bonded to the raceway system; the size of the bonding conductor shall be in accordance with NEC Table 250-122.
 2. Termination of rigid conduit at boxes, cabinets, and enclosures shall be made up tightly with a double-locknut arrangement and a bushing; bushings being of the insulated type where required by NEC.
 3. Where conduit enters or leaves any electrical enclosure with removable cover plates, provide conduit grounding bushings and bonding jumpers sized in accordance with NEC Table 250-122 between the grounding bushings and the enclosure rigid frame or ground bus.
 4. Conduit that runs to or from boxes, cabinets, or enclosures having concentric or eccentric knockouts, which partially perforate the metal around the conduit and hence impair the continuity of system ground circuits, shall be provided with bonding jumpers, sized in accordance with NEC Table 250-122, connected between a grounding type bushing/locknut on the conduit and a ground bus or stud inside the box, cabinet, or enclosure, and attached thereto.
 5. Where flexible metallic conduit and/or liquid-tight conduit is used, a bonding jumper shall be provided, sized in accordance with NEC Table 250-122.
 6. All runs of conduit and/or raceway shall be provided with a system ground conductor sized according to Table 250-122.
- C. Attachment to Structural Steel:
1. Location of attachment bonds of ground conductors shall be at points not subject to mechanical or structural damage, but accessible for inspection. Coordinate exact location. Provide in accordance with NEC.
 2. Attach preferably by molded-fusion-welding process.

3. Where welding is prohibited, attach by bolting, 7/16-inch hole in steel, 3/8-inch silicon bronze bolt, bolt end peened, steel surface bright and flat prior to bolting, just prior to bolting contact surfaces lightly coated with oxide-inhibiting compound.
 4. Bond building addition to existing building in accordance with NEC.
- D. Attachment to Building Foundation:
1. Provide in accordance with NEC.
 2. Attach by molded-fusion-welding process.
- E. Secondary Electrical System:
1. The neutral conductor of low-voltage, single and/or polyphase system or distribution system, except special isolated double-insulated systems, shall be solidly connected at the transformer neutral bushing or at the main secondary service equipment; to system ground and shall be sized for current-carrying capacity, not to be less than the following, which are listed in preferential order:
 - a. As indicated on Contract Drawings.
 - b. As required by NEC Table 250-66 for grounding electrode conductor and Table 250-122 for equipment grounding conductor.
 2. For transformers rated 600 volts or less:
 - a. Provide equipment grounding conductor (green-colored insulation) in same conduit with primary conductors. Connect grounding conductor to ground bus located inside transformer enclosure.
 - b. Provide ground conductor from neutral of secondary winding to ground bus.
 - c. Provide ground conductor from ground bus to nearest metallic pipe, building steel, or ground rod.
 - d. Provide ground conductor from ground bus to panelboard served by transformers.
 3. Provide equipment grounding conductor (green-colored insulation) with phase conductors in each circuit. Insulation shall be same as phase conductors.
 4. Equipment grounding conductors shall extend from the point of termination back to the ground bus of the serving panelboard, switchboard, transformer, or switchgear.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Receptacles with integral surge suppression units.
 - 3. Local switches.
 - 4. Electronic wall-box dimmers.
 - 5. Wall plates.
- B. Related Sections include the following:
 - 1. Division 27 Specifications for workstation outlets.

1.2 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.

1.3 SUBMITTALS

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

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100.
- C. Comply with NFPA 70.

1.5 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names:
 - 1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
 - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 - 3. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).
 - 4. Lutron Electronics, Inc. (Lutron).

- B. Manufacturers' catalog numbers designate series and not wiring device color. For color of devices, refer to "Finishes" article in this Section.

2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6, WC596 (Fed. Spec.) Configuration 5-20R, and UL 498; back and side wired. Extra-heavy-duty industrial grade.
 - 1. Duplex, 2-pole, 3-wire grounding.
 - 2. Parallel blade, double-wipe contacts, NEMA grounding slot.
 - 3. Provide with one-piece, heavy-duty brass strap with integral ground connection. Riveted connections are unacceptable.
 - 4. Products:
 - a. Cooper; 5362 (duplex); extra-heavy-duty industrial grade.
 - b. Hubbell; 5362 (duplex); extra-heavy-duty industrial grade.
 - c. Pass & Seymour; 5362A series (duplex); extra-heavy-duty industrial grade.
- B. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498; back and side wired; Hospital Grade.
 - 1. Products:
 - a. Cooper; TR8300.
 - b. Hubbell; HBL8300SG.
 - c. Pass & Seymour; 63H.
 - 2. Description: Labeled to comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, feed-through type, Hospital Grade. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Trip level 4 to 6 mA: .025-second nominal trip time.
- C. Duplex GFCI Convenience Receptacles; 125 V, 20 A; Hospital Grade:
 - 1. Basis-of-Design Product: Provide Pass & Seymour #20954G or approved equal by one of the following:
 - a. Cooper.
 - b. Hubbell.
- D. Provide GFCI receptacles at all locations required by NEC, all locations indicated in Documents, and at all "WP" outlets indicated in Documents.

2.4 TVSS RECEPTACLES

- A. General Description: Hospital Grade; comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 1449, with integral TVSS in line to ground, line to neutral, and neutral to ground.
 - 1. TVSS Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 500 volts and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45; 125 V, 20 Amp.
 - 2. Active TVSS Indication: Visual and audible, with light visible in face of device to indicate device is "active" or "no longer in service."
 - 3. 7:1 average noise reduction.
 - 4. Red LED indicator to indicate the loss of protection in all three modes and amber LED indicator to indicate positive surge protection.
- B. Duplex TVSS Convenience Receptacles:

1. Basis-of-Design Product: Provide Pass & Seymour #8300 series or approved equal by one of the following:
 - a. Cooper.
 - b. Hubbell.

2.5 USB RECEPTACLE

- A. General Description: Hospital Grade; comply with NEMA WD 1, NEMA WD 6, UL 498, UL 1310, and Fed. Spec. WC 596.
- B. Duplex, 5-20R, 120-V, 20-Amp grounding outlets with two 5-V dc USB ports that work with USB 2.0- and 3.0-compatible devices. Overall 3.1A USB charging capability.
- C. Back- and side-wired terminals.
- D. Duplex USB Receptacles:
 1. Basis-of-Design Product: Provide Pass & Seymour #8300 series or approved equal by one of the following:
 - a. Cooper.
 - b. Hubbell.

2.6 LOCAL SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A; back and side wired:
 1. Basis-of-Design Products: Provide Pass & Seymour #PS20AC1 (single pole), #PS20AC2 (two-pole), #PS20AC3 (three-way), #PS20AC4 (four-way) or approved equal by one of the following:
 - a. Hubbell.
 - b. Cooper.
- C. AC Type: Slow make, slow break, quiet switch action, Industrial Extra-Heavy-Duty Specification Grade.
- D. Key-Operated Switches, 120/277 V, 20 A:
 1. Basis-of-Design Product: Provide Pass & Seymour #PS20AC1-L or approved equal by one of the following:
 - a. Hubbell.
 - b. Cooper.
 2. Description: Single pole, with factory-supplied key in lieu of switch handle, back and side wired.

2.7 ELECTRONIC WALL-BOX DIMMERS

- A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
 1. Basis-of-Design Product: Provide Phillips "Sunrise" series or approved equal by one of the following:
 - a. Hunt.
 - b. Lutron.
- B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.
- C. LED Dimming Switches: Provides 0- to 10-V sinking control, compatible with all LED drivers, compliant to IEC 60929 Annex E.2.

1. Rated 1200 watts at 120 or 277 volts.
2. Large paddle switch with a captive linear dimmer for a standard designer wall plate.
3. Provide a color to match device wall plates.
4. Provide a physical barrier/partition when ganged with line-voltage switches.
5. No derating required when ganged with similar dimmers.

2.8 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: 0.035-inch-thick, satin-finished stainless steel.
 3. Material for Unfinished Spaces: Galvanized steel.
 4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in "wet locations."
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant thermoplastic with lockable cover. Provide at all locations labeled, "WP."
- C. Manufacturer: Same as devices.

2.9 FINISHES

- A. Color: Wiring device catalog numbers in Section text do not designate device color.
 1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing. Provide receptacle in blue-color finish at computer-workstation outlets and at two-section raceway.
 2. Wiring Devices Connected to Emergency Power System or Generator-Served Power System: Red.
 3. TVSS Devices and Devices Circuited to TVSS Panelboards: Blue.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
 1. Duplex Receptacles: 18 inches above finished floor to centerline.
 2. Wall Switch: 48 inches above finished floor to centerline.
- B. Coordination with Other Trades:
 1. Take steps to ensure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.

3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
- D. Device Installation:
1. Replace all devices that have been in temporary use during construction.
 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
 6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
 8. Tighten unused terminal screws on the device.
 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation: Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Dimmers:
1. Install dimmers within terms of their listing.
 2. Verify that dimmers used for fan speed control are listed for that application.
 3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.
- H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.

END OF SECTION

SECTION 26 51 00

INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Interior lighting fixtures, lamps, and ballasts.
 - 2. Emergency lighting units.
 - 3. Exit signs.
 - 4. Lighting fixture supports.
 - 5. Emergency-lighting transfer cabinets.
- B. Related Sections include the following:
 - 1. Division 26 Section "Wiring Devices" for electronic wall-box dimmers, occupancy sensors, and associated devices for LED fixtures.
 - 2. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multi-pole lighting relays and contactors, and lighting control panels.

1.2 DEFINITIONS

- A. CRI: Color-rendering index.
- B. DLC: DesignLights Consortium.
- C. LED: Light-emitting diode.
- D. Luminaire: Complete lighting fixture, including driver housing.

1.3 SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of lighting fixture including dimensions.
 - 2. Emergency lighting units including battery and charger.
 - 3. LED drivers and LED modules/sources.
 - 4. Energy-efficiency data.
 - 5. Life, output, and energy-efficiency data for LEDs with drivers.
 - 6. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with LEDs, drivers, and accessories identical to those indicated for the lighting fixture as applied in this Project.
- B. Samples for Verification: Interior lighting fixtures designated for sample submission in Interior Lighting Fixture Schedule. Each sample shall include the following:
 - 1. LEDs: Specified units installed.
 - 2. Accessories: Cords and plugs.
- C. Operation and Maintenance Data: For lighting equipment and fixtures to include in operation and maintenance manuals.
- D. Warranties: Special warranties specified in this Section.
- E. Field quality-control reports.

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INTERIOR LIGHTING

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100.
- B. Comply with NFPA 70.

1.5 WARRANTY

- A. Minimum warranty of five years on all fixtures unless otherwise specified.

PART 2 - PRODUCTS

2.1 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. LED Fixtures: Comply with UL 1598 and UL 8750.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- E. 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.
- F. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
 - 4. Laminated Silver Metallized Film: 90 percent.
- G. Plastic Diffusers, Covers, and Globes:
 - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least 0.156" minimum unless different thickness is indicated.
 - b. UV stabilized.

2.2 LED DRIVERS

- A. Products:
 - 1. Advance "Xitanium" series.
 - 2. Universal "Evenline" series.
 - 3. Sylvania "Optronic" series.
- B. Description: Comply with ANSI C 82.11, designed for type and quantity of LEDs indicated. Drivers shall be designed for full light output unless dimmer or bi-level control is indicated:

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1. End-of-life detection, signaling, and shutdown circuit.
2. Sound Rating: A.
3. Total Harmonic Distortion Rating: Less than 20 percent.
4. Transient Voltage Protection: IEEE C62.41, Category A or better.
5. Module temperature-control protection.
6. Power Factor: 0.95 or higher.
7. Full five-year warranty, minimum.

2.3 EXIT SIGNS

- A. Basis-of-Design Product: Provide Kenall "Millennium Metrex" series or approved equal by one of the following:
 1. Fail-Safe.
 2. Lithonia.
- B. Description: Comply with UL 924; 6"-high, 3/4"-wide "RED" letters, downlight; universal mounting; universal arrows; single or double face as indicated.
- C. Vandal-resistant, high-impact, injection-molded polycarbonate housing and UV-stabilized, 0.125"-thick shield; matte white exterior color; UL-listed for wet locations.
- D. Provide mounting and support at 4 points for each exit light/base plate.
- E. Provide fixture with lifetime warranty against failure due to vandalism.
- F. Internally Lighted Signs:
 1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.
 2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
 - a. Battery: Sealed, maintenance-free, nickel-cadmium type. Battery size as required to maintain full light/LED output for 90 minutes.
 - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - c. 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.
 - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 - f. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.
 3. Types/Schedule:
 - a. Type X: Wall back-mounted, single-faced unit.
 - b. Type X1: Ceiling-mounted, single-faced unit.
 - c. Type X2: Ceiling-mounted, double-faced unit.
 - d. Type X3: End/wall-mounted, single-faced unit.
 - e. Type X4: End/wall-mounted, double-faced unit.
 - f. Type XN: NEMA 4-type, universal-mounted, single-faced unit with emergency battery lights.
 - g. Type XN2: NEMA 4-type, universal-mounted, double-faced unit.

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- G. Combination Weatherproof Exit Sign/Emergency Battery Light Unit:
1. Red LEDs for AC operation. LEDs rated life 70,000 hours minimum.
 2. Integral automatic battery charger, fully automatic with sealed transfer relay.
 3. Maintenance-free Nicad batteries with a life expectancy of 15 years. Provide internal battery heater to allow operation at temperature of -4 deg F to 122 deg F.
 4. Housing constructed of impact-resistant, corrosion-proof, UV-stabilized polycarbonate with one-piece, molded, weatherproof gasket.
 5. Fully illuminated "EXIT" in 6" characters with 3/4" stroke, field-selectable chevrons.
 6. UL 924-listed.
 7. Field-adjustable, 3.6-watt, LED, emergency lighting heads, two per fixture.
 8. Provide with self-test/self-diagnostics.
 9. Basis-of-Design Product: Exitronix "VEX-WPC" series or approved equal by one of the following:
 - a. Kenall.
 - b. Fail-Safe.
- H. Rated for 120/277 volts.
- I. Provide circuiting to exit signs in accordance with National Electric Code, Article 700.12, circuit exit signs to normal lighting branch circuit serving similar area and circuit ahead of (line side) on all lighting controls.

2.4 EMERGENCY LIGHTING UNITS

- A. Basis-of-Design Product: Provide Exitronix "SCL" series for wall-mounted units and "CRL" series for ceiling-recessed units or approved equal by one of the following:
1. Sure-Lites.
 2. Dual-Lite.
- B. Description: Self-contained units complying with UL 924.
1. Battery: Sealed, maintenance-free, lead-acid type; 12-V, 8-watt output at 90 minutes to end voltage 87-1/2 percent; 10-year life; rated for 120/277 volts.
 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 3. 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.
 4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 6. Protective Shield: Lexan vandal shield where indicated by "WG."
 7. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage.
 8. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.
- C. Types:
1. Wall-mounted units: Provide wall-mounted emergency battery lighting units at locations indicated with the subscript "W," meeting all the general requirements above and the following:
 - a. Heavy-gauge steel housing construction; white powder-coat finish.

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- b. Provide with two 3.6-watt LED lamps, which provide 120 lumens each.
 - c. Provide heavy-gauge steel shelf to mount unit. Provide shelf and mount to support four times the equipment weight.
 - d. Provide heavy Lexan vandal shield at all wall-mounted units.
 - e. Provide unit with remote head capability.
2. Ceiling-recessed units: Provide ceiling-recessed emergency battery lights at locations indicated on the Drawings, meeting all general requirements above and the following:
- a. 20-gauge steel housing, lay-in assembly for grid mounting, white finish.
 - b. Provide with two 3.6-watt LED lamps, which provide 120 lumens each.
 - c. Provide 2 independent supports from units to building structure, similar to lay-in troffer supports.
- D. Circuit emergency battery lights to normal lighting branch circuiting serving similar area. Circuit ahead (line side) of all lighting controls.

2.5 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports, and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2" steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2" steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gauge.
- E. Rod Hangers: 3/16" minimum diameter, cadmium-plated, threaded steel rod.
- F. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

2.6 REQUIREMENTS FOR INDIVIDUAL LIGHTING FIXTURES

- A. Fixture Types/Schedule:
 - 1. Type A:
 - a. Description: LED, ceiling-recessed, lay-in, 2' x 2' x 2-11/16"-deep static unit with fixture frame for mounting in Type "G" grid ceiling. Unit housing shall be rigid, heavily embossed, 22-gauge, die-formed steel with all parts being treated after fabrication with a protective phosphate bonderizing coating, white baked-enamel finish. Optical system components include dual-chamber configuration, each with opal, virgin-acrylic diffusers with large luminous areas. Provide unit with LED source to produce 4670 delivered lumens, 4000 K at 41 watts. Provide with high-performance, 0- to 10-V dimming driver. Driver shall be constant current-reduction type, rated 70,000 hours (L70). Fixture to be DLC-listed and include a full 5-year warranty.
 - b. Basis-of-Design Product: Provide Current/Columbia "TCAT" series or approved equal by one of the following:
 - 1) Eaton/Metalux "Accord" series.
 - 2) Philips/DayBrite "DuaLED" series

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2. Type B:
 - a. Description: LED with Indigo-Clean Technology (ICT), vandal-resistant, ceiling surface-mounted; 5" wide x 24" length x 4" deep unit; Marine-grade aluminum housing; extruded body with die-cast, rounded end caps; one-piece, UV-stabilized, pearlescent, polycarbonate lens with smooth exterior and linear prismatic interior; positive latches at all 4 corners shall hold lens securely in place. Provides on-demand environmental disinfection via LED light. Independent, laboratory tested to kill harmful bacteria including staph, such as MRSA. Serviceable mid-power white and 405 nm Indigo LED array rated 2700 lumens at 31 watts and 3700 K with 0- to 10-V dimming driver. L70 rating of 80,000 hours. UL-listed for wet locations and UL-certified IP 64. Lifetime warranty against failure due to vandalism.
 - b. Basis-of-Design Product: Provide Kenall "Millennium Stretch" series with ICT or approved equal by one of the following:
 - 1) Fail-Safe.
 - 2) Paramount.
3. Type A-C:
 - a. Description: LED with Indigo-Clean Technology, ceiling-recessed, 2' x 2' x 4"-deep static unit with flange fitting for mounting in hard ceiling. Unit shall be rigid, heavily embossed, 20-gauge, die-formed steel with all parts finished in high-reflectance, matte white, powder-coated, paint finish. Co-extruded-acrylic lens with ribbed side channels. Provide unit with LED source of on-demand environmental disinfection via LED light. Independent, laboratory tested to kill harmful bacteria including staph, such as MRSA. Serviceable mid-power white and 405 nm Indigo LED array to produce 5401 lumens at 59 watts and 3700 K. Provide with high-performance, 0- to 10-V dimming driver. Fixture with L90 rating of 100,000 hours, L70 rating of 200,000 hours.
 - b. Basis-of-Design Product: Provide Finelite "HPR" series or approved equal.
4. Type C:
 - a. Description: LED, pendant-mounted, 3-1/2"-wide x 3-1/2"-high x 24" linear luminaire; heavy-gauge, cold-rolled steel housing steel end caps; rugged, radiused, 100 percent frosted acrylic lens; all parts painted in high-reflectance white, baked enamel; surface- or pendant-mount, coordinate each location; pendant-mount fixtures with 1/4"-diameter galvanized threaded rods with washers, double nuts, and steel channel systems. Coordinate locations with HVAC and plumbing system layouts. Provide luminaire with 4000 K LED source to produce 2600 lumens at 20 watts. Provide with high-efficiency LED driver. Rated 120,000 hours (L70). Coordinate exact mounting height with Architect prior to roughing. DLC Premium-listed.
 - b. Basis-of-Design Product: Provide Trace-Lite "SLS" series or approved equal by one of the following:
 - 1) Metalux.
 - 2) Lithonia.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lighting Fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- B. Interior Lighting Fixtures:

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1. Location:
 - a. Evenly proportioned in room except where otherwise shown or dimensioned.
 - b. Edges of lighting fixtures parallel with walls.
2. Mounting:
 - a. Provide independent and isolated support from building structure for each fixture; supporting from a suspended ceiling system is unacceptable.
 - b. Lighting fixtures must hang true to vertical, free from finger marks, flaws, scratches, dents, or other imperfections.
 - c. Take care when hanging fixtures not to deface in any way the ceilings or walls.
 - d. Install continuous rows of lighting fixtures in straight line; all fixtures at same level. Fixtures must not be rotated about longitudinal axis with respect to one another.
 - e. Mount surface lighting fixtures tight to surface without distorting it. Minimum of two supports per fixture.
 - f. Provide special means for supporting fixtures as hereinafter specified, as indicated on Contract Drawings or as required.
 - g. Stem-mounted lighting fixtures shall be hung level from self-aligning hangers.
 - h. Securely support lighting fixtures, hangers, and outlet boxes.
 - i. Plastic inserts not permitted.
 - j. Outlet boxes shall not be supported by conduit.
 - k. Supports for each fixture shall be capable of supporting four times fixture weight.
 - l. Recessed lay-in troffers shall be securely fastened to building structure by means of wire supports independent of ceiling structure.
 - 1) 2' x 4': 2 supports/fixture.
 - 2) 1' x 4': 2 supports/fixture.
 - 3) 2' x 2': 2 supports/fixture.
 - m. Secure each fixture housing to support grids at four locations using tabs or clips provided with fixtures.
 - n. Surface- and suspended-type fixtures: Up to 4' length, provide 2 supports; greater than 4', provide four supports.
 - o. Support means shall be one of the following:
 - 1) Schedule 10, steel wire.
 - 2) 1/4"-diameter, galvanized, threaded rod with washers and double nuts.
 - 3) Specifically designed hangers and clamps (by luminaire manufacturer).
 - 4) Rigid steel conduit with threaded fittings.
 - 5) Steel channel systems.
 - 6) Suspension stems supplied by luminaire manufacturer.
 - p. Fastening and Anchoring Means:
 - 1) At steel structures, fasten to roof or floor structural members using acceptable clamps. Steel wires may be looped through joists and twisted.
 - 2) At concrete structures, provide drilled in anchors or concrete inserts. Coordinate locations with reinforcing steel.
 - q. Provide special mounting as indicated on selected fixture details. Refer to Contract Drawings.
 - r. Recessed downlights shall be supported from main ceiling channels, not intermediate channels with supplement wire support from fixture to building structure independent of ceiling structure.

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INTERIOR LIGHTING

- s. Special support system shall be provided for master/slave intertie cable. Refer to 1999 NEC, Section 300-11a.
- t. Provide 4 attachments/supports for each exit light.
- 3. Mechanical Coordination:
 - a. Coordinate location of hangers, in areas without ceilings, with ductwork, plumbing piping, etc.
 - b. Make necessary offsets and extensions so that stems and lighting fixtures avoid beams, pipes, ducts, etc.
 - c. Where fixtures are located below heating, ventilating units, and/or ductwork and piping, provide trapeze hangers around obstruction and suspend fixture from trapeze hanger.
- 4. Architectural Coordination:
 - a. Coordinate ceiling layouts with General Contractor.
 - b. Heights and lighting fixtures not scheduled will be furnished on application to Architect.
 - c. Verify ceiling construction and report in writing any discrepancies between the ceiling type and the lighting fixture type before releasing lighting fixture for manufacture.
 - d. Verify mounting heights for each wall and suspended luminaire and/or exit sign prior to roughing; bottom of housing shall not be less than 80" above floor in any area.

3.2 CARE OF FIXTURES

- A. Remove broken glassware, plastic, or fixtures damaged, and replace with new before final acceptance with no additional cost added to the Contract.
- B. No allowance made for breakage or theft before final acceptance.
- C. Immediately prior to occupancy, damp-clean all diffusers, glassware, fixture trims, and reflectors. Replace all burned-out lamps.

3.3 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. Perform testing of lighting fixtures and associated branch circuitry for proper operation after installation has been completed.
- C. Prepare a written report of tests.

END OF SECTION

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ATHLETIC FIELD LIGHTING (BASE BID)

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide athletic field lighting system (light fixtures, poles, pole bases, foundation, and lighting controls, including LED sports lighting system with factory prewired and pre-aimed fixtures) as outlined in the Contract Documents.
- B. Section Includes:
1. Providing a complete athletic field lighting system at the main facility athletic complex, including but not limited to:
 - a. Luminaires, platforms, steel poles, concrete bases, and accessories for field lighting fixture assemblies.
 - b. Lighting contactors, feeders, branch circuitry to and final connections at each field lighting pole/fixture assembly.
 - c. Complete wireless lighting control cabinet at Press Box building for overall lighting-system control.
 - d. Luminaires, platform and electrical system shall be UL listed and manufactured within the United States.
 2. Transporting, receiving, and unloading of poles, fixtures, and accessories to construction site/assembly area. Provide necessary equipment for unloading.
 3. Receiving, unloading, transporting to assembly area and storing field lighting fixtures with lamps.
 4. Assembling, erecting, and complete installing of field lighting fixture assemblies.
 5. Testing each field lighting fixture and adjusting required light fixtures to meet design criteria.
- C. Related Documents:
1. Divisions 31 and 32 Site Construction Specifications, including Geotechnical Data/Report.
 2. Division 26 Sections "General Requirements for Electrical."
 3. Division 26 Section "Earth Moving for Electrical."
 4. Division 26 Section "Underground Ducts and Raceways for Electrical Systems."
 5. Division 26 Section "Low-Voltage Electrical Transmissions."

1.2 SYSTEM DESCRIPTION

- A. Intent of these Specifications:
1. Provide all components required to complete total operating system as called for in these Specifications and as indicated on the Contract Drawings. Coordinate installation of components with all trades.
 2. Provide all wiring and conduit required to interconnect the various components.
 3. The play field is located in an area with varying grade elevations at each pole location and at each side of the field. Special attention shall be given to pole heights.
- B. Lighting System:
1. Playing Area:
 - a. Soccer Field: 225' wide, 360' long.
 - b. Lighting Fixture Head Heights above Finished Field Surface, Grade Level at Exact Center of Field:

- c. Poles P1, P2, P3, and P4: 80 feet.
 - d. Pole heights may vary based on finished grade elevations and in-ground depth as recommended by pole manufacturer based upon boring investigation.
 - 2. Field-lighting fixture assemblies shall be located as indicated on the Contract Drawings.
 - 3. Field-lighting fixture assemblies shall be provided with pole-mount electrical components' enclosures stacked on back side of each pole. Mounting height to first housing 10'-0"± from finished grade.
 - 4. Maintained illumination levels 36" above the finished field surface with no less than 40 footcandles maintained anywhere on soccer field.
 - a. The average maintained foot candle level on the field shall be 50 foot candles.
 - 5. Maximum to minimum ratio for horizontal footcandles shall be 1.6:1 maximum.
 - 6. Field Measuring Grid:
 - a. Soccer: 84 points covering 225 x 360 (ft) on an equally spaced 30' x 30' grid.
 - 7. Light loss factor to be used in calculations shall be .90 maximum.
 - 8. Illumination source: 770-watt LED fixtures, 99,246 lumens, 5000 K; CRI shall be 70 minimum. L90 rating of 150,000 hours.
 - 9. Lamp lumens to be utilized for the computer modeling calculations shall be taken at "0-hours."
 - 10. Class of Play: Class II.
- C. Field Security Lighting: Provide security lighting capabilities at each pole with programming and control from wireless lighting control system.
 - D. Maximum Lighting Load: 50 kW.
 - E. Transportation: Provide all necessary transportation from plant to construction site and unloading of poles, concrete bases, and accessories at construction site.
 - F. Pole Assemblies' and In-Ground Design:
 - 1. Pole manufacturer shall be responsible for the design of each pole assembly's base/footing requirements. Concrete-base designs shall be based on boring test report. Refer to attached Geotechnical Data/Report.
 - 2. Each pole assembly's design data shall be submitted to the Division 26 Contractor for execution. Data shall be sufficient for proper installation by Division 26 Contractor.
 - 3. Pole and in-ground depth design must be by New York State-licensed structural engineer. Respective engineer shall witness installation of pole complete including in-ground installation.

1.3 SUBMITTALS

- A. Shop Drawings for the following:
 - 1. Complete concrete pole and lighting fixture assembly.
 - 2. Printouts (30' x 30' grid) of maintained lighting levels for the soccer field.
 - 3. Spill light to be included in printouts a distance of 100' from pole location.
 - 4. Show kW electrical load per pole. Show complete electrical wiring diagram with fuses, wire sizes and quantities.
- B. Stamped, signed, and dated drawings by NYS-licensed structural engineer detailing pole-base design with pole.
- C. Operating and maintenance data for the complete lighting system.
- D. Specified warranty.

1.4 QUALITY ASSURANCE

- A. All equipment shall be new and of high quality. To set a uniform standard of quality, the manufacturer of the fixture assemblies shall have been continuously manufacturing fixture assemblies for at least 10 years. All equipment furnished under these Specifications shall be listed by Underwriters' Laboratories and bear the UL label.

1.5 WARRANTY

- A. The equipment manufacturer shall warrant his equipment and lighting level for a period of 10 years from start-up. Manufacturer shall agree to correct and/or replace, at no expense to the Owner, all defects due to workmanship or materials occurring under normal operating conditions during the warranty period. Guarantee shall include total fixture replacement for the full duration (10 years) of the warranty period.
- B. Provide a one-year warranty on the alignment and aiming of all sports lighting. Warranty to include any adjustments and re-aiming required during the one year warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Carolina High Mast "Sports Lighting-USR2" series system or approved equal by Cooper/Ephesus.

2.2 POLE FOUNDATION

- A. General:
 - 1. Poured-in-place concrete backfill as detailed on Drawings and approved by the Structural Engineer.
 - 2. Designed to needs of geotechnical evaluation of field borings. Refer to Geotechnical Data/Report.

2.3 FIELD LIGHTING FIXTURE ASSEMBLIES

- A. Pole Structure:
 - 1. General: Round, galvanized steel, galvanizing as a minimum shall meet the requirements of ASTM A123; miscellaneous hardware, galvanized to ASTM A153; integral ground lug. Provide handhole, steps, safety cable, and safety harness. Steel shall meet ASTM A572, Gr. 65.
 - 2. Loading: Pole shaft shall be designed to accommodate vertical forces due to pole weight, light fixtures, attachments, service cage, and one maintenance man, and a 90-mph wind with a 3-second gust in accordance with AASHTO LTS-5.
- B. Light Fixture Cross-Arms:
 - 1. General: Galvanized steel, galvanizing as a minimum shall meet all the requirements of ASTM A 123; tubular design to reduce wind drag; light fixture supports per manufacturer standards. Cross-arms and accessories to withstand 90-mph wind with 3-second gust in accordance with AASHTO LTS-5.
 - 2. Wiring: Light fixture wiring shall be factory-prewired through cross-arm(s) to a molded weather-tight inlet at each fixture location. Wiring shall terminate in factory-wired connector for easy connection to cable harness via factory-built wiring harness.
 - 3. Inlet shall connect to molded 3-pin connector that is shipped factory-wired to the luminaire.

- C. Pole Assemblies:
1. The following are the required lighting fixture assemblies. Each assembly is identified by number and a general description of required components.
 - a. Pole P1: Overall height from finished grade at center point of playing field, up to top row of light fixtures shall be 80' with caged service platform with service steps (service steps to start at 20 feet above grade) and safety harness, electrical components' enclosures, and field light fixtures as required to meet the soccer field lighting design criteria.
 - 1) Provide the following additional component: Mounting bracket for 4 sound system speakers. Mount at 40'-0" above finished grade.
 - b. Pole P2: Same as described for Pole P1.
 - c. Poles P3 and P4: Same as described for Pole P1 except delete mounting bracket for speakers.
- D. Luminaire:
1. Luminaire Assembly:
 - a. The luminaire shall be listed to standard UL1598 by NVLAP laboratory (e.g. UL, CSA, ETL, etc.) and have a minimum ambient temperature rating of 40C. Manufacturer shall submit the Authorization to Mark (ATM) supplied by the applicable NVLAP as proof of safety listing and verification that final manufacturing point is within the United States.
 - b. Each floodlight shall be a complete assembly of LED assembly, driver, optics, and housing. Install with a common mounting assembly designed to allow each floodlight to be removed/replaced as a single unit.
 - c. Luminaire shall accept power at the mounting location provided by remote driver enclosure mounted lower on the pole.
 - d. Each floodlight shall have a Grade 304 stainless steel mounting yoke for attachment to the cross arms. The mounting yoke shall be a minimum thickness of 0.3125."
 - e. Shall be factory wired with dedicated wireless control module to provide dimming and on/off control as part of a complete wireless mesh network control system.
 - f. Individually labeled showing fixture number, tower designation and location on the structure.
 - g. Each luminaire shall be provided with a factory wired 3' length of 16/3 STOOW with a molded 3 pin connector to permit electrical attachment in the field without the need to hardwire the system.
- E. Remote Driver Enclosure:
1. The entire remote driver enclosure (ROE) shall be safety listed to UL1598. Cabinets that are not manufactured by the luminaire manufacturer, are assembled in the field by the contractor or are not listed to UL1598 as a complete system will not be accepted.
 2. Cabinet shall have a single incoming AC power landing to accept pole base electrical supply.
 3. Each driver, fusing and all corresponding wiring shall be clearly labeled with driver ID # with permanent labels.
 4. Provide a manual-operated, UL-listed, rotary type disconnect (3-pole) switch, fusing, & lugs, in a pre-wired weatherproof NEMA 4 Aluminum enclosure. Cover shall have full-length piano hinge. Provide enclosure pre-wired and complete, ready for installation on pole at job site.
 5. Panel Mounting Height: Install on pole with bottom of enclosure at approximately 12 feet above finish grade. Pole shall be supplied with integrally welded mounting nuts. Floodlight wire harness exits disconnect and goes into pole through gasketed opening.

6. All electrical terminations for AC, DC out and wireless controls (dimming/12V DC) shall be made on DIN Rail mount style terminal blocks. Terminations with wire nuts, splices or WAGO style connections for these terminations will not be accepted.
7. Provide a ground lug for connecting grounding conductor run with pole feeder to pole.
8. Each RDE shall have a permanent, outdoor rated label on the bottom side of the enclosure with a unique ID number that is visible from the ground for installation validation and troubleshooting.
9. LED Driver Requirements
 - a. There shall be (1) driver per luminaire powering each luminaire with no more than a single pair of conductors (single channel) of DC power. Systems that power more than one luminaire per driver or utilize multiple drivers per luminaire will not be accepted.
 - b. To ensure uniform operation of the LED over a wide range of operating temperatures, the driver shall be constant current. The driver shall compensate for any voltage drop on conductors between the driver and luminaire automatically to ensure proper drive current to the LED array. Constant voltage or constant power solutions will not be accepted.
 - c. LED shall be operated at a drive current that is no more than 50% of the absolute maximum allowable drive current as specified within the LED manufacturer cut sheet for the diode used within the luminaire.
 - d. Driver shall come standard with 0-10V dimming, 12V auxiliary power and dim to off technology to allow the future addition of a wireless control system to turn off the luminaires without the need for contactors or relays.
 - e. Drivers shall be mounted to the enclosure with (4) hex head fasteners that do not need to be fully removed in order to remove the driver.
 - f. Each driver in the driver enclosure shall have a dedicated, extruded aluminum heat sinking housing to ensure consistent and reliable operation of the driver.
 - g. THD shall be no more than 20%.
 - h. Driver shall be UL Listed for Wet Location and be IP67 rated.
 - i. Power Factor >0.95

F. Optical Assembly:

1. General:
 - a. The fixture shall be of heavy-duty construction.
 - b. The LED housing shall be constructed of cast aluminum.
 - c. The optical assembly shall include an impact and thermal resistant tempered glass lens of no less than 0.15" thickness. Any material other than glass as the LED enclosure will not be accepted.
 - d. Each luminaire shall have a dedicated optical constructed of PMMA
 - e. LED boards shall be modular in design such that failure of any one LED board or driver will not reduce total luminaire output by more than 50%.
 - f. Wire to board electrical connections shall be made with poke-in style connectors only. Solder joints will not be accepted.
 - g. Factory new LED modules and replacement modules shall be supplied by the manufacturer with factory applied graphite thermal interface material. This eliminates the need to apply thermal interface in the field and allows installation of a replacement module without having to clean the heat sink. Thermal grease or phase change material as the module TIM will not be accepted.
2. Glare Control:
 - a. Glare and spill lighting is of a major concern on this project. As such, each luminaire shall be supplied with internal glare control that provides

total glare cut off in all viewing angles (top, sides and bottom viewing angle of luminaire).

- 1) Luminaires that offer only top visor control will not be accepted due to unacceptable glare on field.
- b. Glare control ribs shall extend from top side of LED optic a minimum of 13mm beyond the optic to provide full and complete glare cut off in all directions.
- c. Glare control material shall be of a matte black finish to reduce secondary reflected glare off the control ribs.
- d. Photometric reports and tests shall include glare control as specified.
- e. Luminaires that propose to use "TIR" optic technology as their sole method of glare mitigation will not be accepted. Unit must have "egg crate" style, matte black internal glare control.
- f. External methods of glare control (visors, louvers, baffles, etc.) are not effective at controlling glare in LED luminaires and will not be considered an acceptable alternative to a complete, internal glare control solution.

G. LED:

1. LED Characteristics:

- a. LED shall generate light that is 5000K CCT. CCT higher than 5000K will not be accepted.
- b. CRI shall be 70 CRI minimum; 70 CRI typical diodes will not be accepted.
- c. LED shall be "high power" in design and shall incorporate a base mounting material of either ceramic or aluminum. "Mid-power" LEDs like traditional "3030" or "5050" packages that utilize a plastic base material will not be accepted due to unacceptable long-term color shift, high lumen depreciation and extreme susceptibility to chemical attack in an outdoor environment.

2. Manufacturers: Nichia, Cree, Seoul.

H. Fixture Wiring in Pole:

1. Factory shall furnish multi-conductor cable harness of minimum No. 12 AWG designed for suspension inside the pole. Cable harness shall be designed to resist high abrasion and flexing. Cable harness shall be rated 600 V, 105C, and UL listed, and CSA classified. Standard building wire such as THWN is not acceptable. Furnish cable with appropriate suspension device.
2. Every cable shall include a grounding conductor.

2.4 MOUNTING STRUCTURES

A. Design Criteria:

1. Provide Sports Lighting Pole Systems including an anchor base tower, concrete foundation, and tubular service platforms with mounting provisions for luminaires.
2. Tower fabrication plant shall be AJSC Certified. Towers fabricated in a Non-AI SC production facility will not be accepted.
3. Minimum Basic Wind Speed: 130 mph 3 second gust
4. Design Criteria: AASHTO LTS-6, non-fatigue

B. Pole Shaft:

1. Each section of the pole shaft shall be of a single ply and be made from length of steel with no welded circumferential splices. Each slip joint shall be assembled in the field by telescoping the upper section over the lower section by a minimum lap of 1.5 times the largest inside diameter of the upper section. The pole shaft sections shall be high strength steel meeting the requirements of ASTM A572 Grade 65.

2. Base weld shall be 100% penetration T-Weld
 - a. Socket type welds shall not be accepted
 - b. Base weld shall be 100% inspected via Ultrasonic or Radiographic methods by an AWS CWI (Certified Weld Inspector).
 3. The long seam shall have a minimum penetration of 60% along the length of the weld
 - a. 100% penetration of the seam weld shall be in following locations
 - 1). Female section of the slip joint+ 6"
 - 2). Bottom 6" of the base tube
 - b. Full penetration sections of the seam weld shall be 100% UT inspected
 4. Assembly: Factory-mark full telescoping points of all pole slip joints and match-mark all sections. Furnish pole assembly procedure with suggested equipment.
 5. The tower shall be inspected by an AWS (American Welding Society) CWI (Certified Welding Inspector) per the latest edition of AWS D1.1. Reports shall be submitted upon fabrication from an AWS CWI certifying the base welds have passed ultrasonic inspection per the latest edition of A WS D1. I
 6. Assembly: Factory-mark full telescoping points of all pole slip joints and match-mark all sections. Furnish pole assembly procedure with suggested equipment.
 7. Provide galvanized steel service steps at each pole, starting at 20 feet above grade up to maintenance cage.
- C. Hot Dip Galvanizing:
1. Assembled pole sections shall be individually hot-dipped galvanized in accordance with the requirements of ASTM A123. Each component must be completely coated in a single dip. No double dipping will be allowed. All miscellaneous hardware shall be galvanized per ASTM A153.
- D. Foundation:
1. The manufacturer self repair a foundation design stamped by a NY Licensed Professional Engineer (PE).
- E. Tubular Service Platform Structural Strength – The platform, luminaire, and method of mounting shall be provided by the manufacturer such that it will structurally withstand 125 mph winds with 1.3 gust factor without misalignment or any damage to the crossarm or its components.
- F. Maintenance Service Cage:
1. Provide maintenance service cage and platform at each pole constructed of heavy gauge galvanized steel with platform and structure to encompass lighting fixture array on back of fixtures. Provide with expanded metal floor with hinged access door with stainless steel hardware to allow securing door from below.

2.5 WIRELESS CONTROLS

- A. General:
1. The wireless control system shall be wireless mesh technology. Each luminaire shall be provided with a factory integrated wireless control that is uniquely identified for fixture number, location and aiming coordinates. Each fixture shall be individually addressable and controllable for full continuous dimming from 10% to 100% and shall be able to be completely switched off with dim-to-off technology via the control node. The main control unit shall be provided by the manufacturer within a NEMA4X non-metallic enclosure for mounting on an exterior wall by the contractor. The only wiring terminations the contractor should be required to make is 120V input to the control base station and connection of LAN cable to provide internet access to the controller. The control system shall be commercially available such that future luminaires purchased by the end user from any manufacturer can be optioned with either an internal controller or 7 PIN dimming receptacle for integration to the system. The entire wireless control

system shall be provided and warranted by the sports lighting manufacturer. All service, programming and training shall be provided by the sports lighting manufacturer and not by a 3rd party.

- B. Central Base Station (Main Controller):
1. Contained within NEMA 4X non-metallic enclosure
 2. Incorporates cellular SIM card such that that manufacturer to gain access to the system with or without LAN access for programming, training, and troubleshooting
 3. Provide five push buttons that are factory programmed to user identified scenes. Example scene summary shown below:
 - a. 100% On
 - b. 50% Dim
 - c. Security
 - d. Open
 - e. Open
 4. The control system shall be able to be controlled via use of the push buttons, wireless control apps for smart phone or tablet or via an internet portal.
 5. Shall have the capacity to control up to 500 luminaires to provide the end user the ability to expand the control system in the future.
- C. Wireless Control Node:
1. Contained internal of each luminaire
 2. To ensure long term reliability of the control system, the control node shall not receive power from the AC mains. The Controller shall receive 12V power directly from one of the LED drivers in the luminaire.
 3. The Controller shall provide standard 0-10V dimming commands to the drivers within the luminaire.
 4. The control node shall be able to be serviced and replaced within the luminaire without removal of the luminaire from the tower.
 5. The manufacturer is responsible for identifying and locating all luminaires on the job site such that they can remotely identify and control each luminaire.
- D. Communication Costs:
1. The system shall provide wireless control and monitoring via LAN connection provided by the end user. Any additional costs to operate the control system for a period of 5 years including software costs shall be paid for by the manufacturer.
- E. Training:
1. Sports Lighting Manufacturer shall provide a training session for the end user after installation and commissioning of the system. Training shall discuss programming, operation and use of the control system. Manufacturer shall provide a minimum of 8 hours of custom programming time if required to ensure the 5 control scenes are to the liking of the end user. Each control scene shall be designed to provide adequate and safe illuminate of the sports fields while minimizing energy consumption on the job site. Each scene shall be achieved via selectively dimming or switching on/off luminaire across the site.
- F. Commissioning and Training:
1. One-day controls engineering calibration and training visit shall be included in manufacturer proposal.
 2. Controls engineer shall ensure the system is installed and operating correctly and ensure control nodes are operating on latest firmware.
 3. Initial programming, grouping, and scheduling of system shall be provided by control engineer both on site and after the visit.
 4. Contractor shall ensure controls engineer has complete and unrestricted access to the lighting system and controls. If the controls engineer is required to stay

beyond one working day due to site conditions or added scope, the contractor shall pay for added costs.

2.6 MISCELLANEOUS

- A. Refer to other Division 26 Sections for:
 - 1. Conduit.
 - 2. Conductors.
 - 3. Lighting contactors.
 - 4. Weatherproof enclosures.
 - 5. Miscellaneous electrical items.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Complete installation shall conform to the National Electric Code and system manufacturer's instructions.
- B. Location: As required by manufacturer's design. Division 26 Contractor shall be responsible for site layout of each assembly.
- C. Mounting: In strict accordance with manufacturer's instructions.
- D. Grounding:
 - 1. According to the requirements of the NEC.
 - 2. Bond pole to system equipment ground and external ground rod.
- E. Balance loads at each assembly so that each phase of the feeder circuit is plus or minus 5 percent among all phases.

3.2 CARE OF ASSEMBLIES

- A. Perform an on-site inspection and accept delivery of poles and accessories prior to unloading from transportation vehicle. Acceptance shall imply that pole and accessories are free from defective or damaged components.
- B. If defective or damaged components are found at on-site inspection, bring to manufacturer's attention so that manufacturer can replace with new, with no additional cost added to the Contract.
- C. Remove all broken glassware or fixtures damaged, and replace with new before final acceptance, with no additional cost added to the Contract.
- D. No allowance made for breakage or theft before final acceptance.
- E. Immediately prior to acceptance, clean all poles, fixtures, accessories. Replace all burned-out lamps, defective ballasts.

3.3 TESTING/ADJUSTING

- A. All luminaires shall be operating and properly aimed.
- B. Coordinate with the manufacturer's representative the testing of respective equipment for proper operation after installation. Test lighting fixtures, branch circuitry and circuit load balance. Lighting fixtures shall be tested as a complete system.

- C. The system shall be turned on at least 60 minutes prior to testing to ensure the system has reached operating temperature.
- D. Adjust each light fixture on each lighting fixture assembly after all assemblies are set in their final position. Adjustments shall be made until submitted lighting levels have been met. Testing and adjusting for each field shall be as follows:
 - 1. Pie-plate field (witnessed by Owner's Representative).
 - 2. Have factory representative take footcandle reading at each coordinate.
 - 3. Adjust light fixtures as required until submitted lighting levels have been met.
 - 4. Photometer shall be of good quality and accuracy.
- E. Tests shall be taken when the air is clear and recently calibrated. Photometer shall be designed to measure sports lighting applications with multiple light fixtures shining on the meter. Extraneous light is at a minimum.
- F. Field-measurements method shall be in accordance with Annex B of IES RP-6.
- G. Include in Bid an additional 24 premium-rate man hours to return to site to readjust light fixtures after the first light readings are taken by factory representative.

END OF SECTION

SECTION 26 55 69

ATHLETIC FIELD LIGHTING (ALTERNATE)

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide athletic field lighting system (light fixtures, poles, pole bases, foundation, and lighting controls, including LED sports lighting system with factory prewired and pre-aimed fixtures) as outlined in the Contract Documents.
- B. Section Includes:
1. Providing a complete athletic field lighting system at the main facility athletic complex, including but not limited to:
 - a. Luminaires, platforms, steel poles, concrete bases, and accessories for field lighting fixture assemblies.
 - b. Lighting contactors, feeders, branch circuitry to and final connections at each field lighting pole/fixture assembly.
 - c. Complete wireless lighting control cabinet at Press Box building for overall lighting-system control.
 - d. Luminaires, platform and electrical system shall be UL listed and manufactured within the United States.
 2. Transporting, receiving, and unloading of poles, fixtures, and accessories to construction site/assembly area. Provide necessary equipment for unloading.
 3. Receiving, unloading, transporting to assembly area and storing field lighting fixtures with lamps.
 4. Assembling, erecting, and complete installing of field lighting fixture assemblies.
 5. Testing each field lighting fixture and adjusting required light fixtures to meet design criteria.
- C. Related Documents:
1. Divisions 31 and 32 Site Construction Specifications, including Geotechnical Data/Report.
 2. Division 26 Sections "General Requirements for Electrical."
 3. Division 26 Section "Earth Moving for Electrical."
 4. Division 26 Section "Underground Ducts and Raceways for Electrical Systems."
 5. Division 26 Section "Low-Voltage Electrical Transmissions."

1.2 SYSTEM DESCRIPTION

- A. Intent of these Specifications:
1. Provide all components required to complete total operating system as called for in these Specifications and as indicated on the Contract Drawings. Coordinate installation of components with all trades.
 2. Provide all wiring and conduit required to interconnect the various components.
 3. The play field is located in an area with varying grade elevations at each pole location and at each side of the field. Special attention shall be given to pole heights.
- B. Lighting System:
1. Playing Area:
 - a. Soccer Field: 225' wide, 360' long. Track oval area is at perimeter of field as indicated on plans.
 - b. Lighting Fixture Head Heights above Finished Field Surface, Grade Level at Exact Center of Field:

- c. Poles P1, P2, P3, P4, P5 and P6: 90 feet.
 - d. Pole heights may vary based on finished grade elevations and in-ground depth as recommended by pole manufacturer based upon boring investigation.
 - 2. Field-lighting fixture assemblies shall be located as indicated on the Contract Drawings.
 - 3. Field-lighting fixture assemblies shall be provided with pole-mount electrical components' enclosures stacked on back side of each pole. Mounting height to first housing 10'-0"± from finished grade.
 - 4. Maintained illumination levels 36" above the finished football/soccer/lacrosse field surface with no less than 40 foot candles maintained anywhere on soccer field and 24 foot candles maintained on the track.
 - a. The average maintained foot candle level on the field shall be 50 foot candles.
 - b. The average maintained foot candle level on the track surface shall be 30 foot candles
 - 5. Maximum to minimum ratio for horizontal footcandles shall be 1.6:1 maximum. For the field and 1.6:1 maximum for the track.
 - 6. Field Measuring Grid:
 - a. Soccer: 84 points covering 225 x 360 (ft) on an equally spaced 30' x 30' grid.
 - b. Track: 47 points in a grid along a poly line at midpoint of track at 30 ft spacing to derive 47 points.
 - 7. Light loss factor to be used in calculations shall be .90 maximum.
 - 8. Illumination source: 770-watt LED fixtures, 99,246 lumens, 5000 K; CRI shall be 70 minimum. L90 rating of 150,000 hours.
 - 9. Lamp lumens to be utilized for the computer modeling calculations shall be taken at "0-hours."
 - 10. Class of Play: Class II.
- C. Field Security Lighting: Provide security lighting capabilities at each pole with programming and control from wireless lighting control system.
 - D. Maximum Lighting Load: 75 kW.
 - E. Transportation: Provide all necessary transportation from plant to construction site and unloading of poles, concrete bases, and accessories at construction site.
 - F. Pole Assemblies' and In-Ground Design:
 - 1. Pole manufacturer shall be responsible for the design of each pole assembly's base/footing requirements. Concrete-base designs shall be based on boring test report. Refer to attached Geotechnical Data/Report.
 - 2. Each pole assembly's design data shall be submitted to the Division 26 Contractor for execution. Data shall be sufficient for proper installation by Division 26 Contractor.
 - 3. Pole and in-ground depth design must be by New York State-licensed structural engineer. Respective engineer shall witness installation of pole complete including in-ground installation.

1.3 SUBMITTALS

- A. Shop Drawings for the following:
 - 1. Complete concrete pole and lighting fixture assembly.
 - 2. Printouts (30' x 30' grid) of maintained lighting levels for the soccer field and complete plan of track area with maintained lighting levels.
 - 3. Spill light to be included in printouts a distance of 100' from pole location.
 - 4. Show kW electrical load per pole. Show complete electrical wiring diagram with fuses, wire sizes and quantities.

- B. Stamped, signed, and dated drawings by NYS-licensed structural engineer detailing pole-base design with pole.
- C. Operating and maintenance data for the complete lighting system.
- D. Specified warranty.

1.4 QUALITY ASSURANCE

- A. All equipment shall be new and of high quality. To set a uniform standard of quality, the manufacturer of the fixture assemblies shall have been continuously manufacturing fixture assemblies for at least 10 years. All equipment furnished under these Specifications shall be listed by Underwriters' Laboratories and bear the UL label.

1.5 WARRANTY

- A. The equipment manufacturer shall warrant his equipment and lighting level for a period of 10 years from start-up. Manufacturer shall agree to correct and/or replace, at no expense to the Owner, all defects due to workmanship or materials occurring under normal operating conditions during the warranty period. Guarantee shall include total fixture replacement for the full duration (10 years) of the warranty period.
- B. Provide a one-year warranty on the alignment and aiming of all sports lighting. Warranty to include any adjustments and re-aiming required during the one year warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Carolina High Mast "Sports Lighting-USR2" series system or approved equal by Cooper/Ephesus.

2.2 POLE FOUNDATION

- A. General:
 - 1. Poured-in-place concrete backfill as detailed on Drawings and approved by the Structural Engineer.
 - 2. Designed to needs of geotechnical evaluation of field borings. Refer to Geotechnical Data/Report.

2.3 FIELD LIGHTING FIXTURE ASSEMBLIES

- A. Pole Structure:
 - 1. General: Round, galvanized steel, galvanizing as a minimum shall meet the requirements of ASTM A123; miscellaneous hardware, galvanized to ASTM A153; integral ground lug. Provide handhole, steps, safety cable, and safety harness. Steel shall meet ASTM A572, Gr. 65.
 - 2. Loading: Pole shaft shall be designed to accommodate vertical forces due to pole weight, light fixtures, attachments, service cage, and one maintenance man, and a 90-mph wind with a 3-second gust in accordance with AASHTO LTS-5.
- B. Light Fixture Cross-Arms:
 - 1. General: Galvanized steel, galvanizing as a minimum shall meet all the requirements of ASTM A 123; tubular design to reduce wind drag; light fixture

- supports per manufacturer standards. Cross-arms and accessories to withstand 90-mph wind with 3-second gust in accordance with AASHTO LTS-5.
2. Wiring: Light fixture wiring shall be factory-prewired through cross-arm(s) to a molded weather-tight inlet at each fixture location. Wiring shall terminate in factory-wired connector for easy connection to cable harness via factory-built wiring harness.
 3. Inlet shall connect to molded 3-pin connector that is shipped factory-wired to the luminaire.
- C. Pole Assemblies:
1. The following are the required lighting fixture assemblies. Each assembly is identified by number and a general description of required components.
 - a. Pole P1: Overall height from finished grade at center point of playing field, up to top row of light fixtures shall be 90" with caged service platform with service steps (service steps to start at 20 feet above grade) and safety harness, electrical components' enclosures, and field light fixtures as required to meet the soccer field lighting design criteria.
 - 1) Provide the following additional component: Mounting bracket for 4 sound system speakers. Mount at 40'-0" above finished grade.
 - b. Pole P3: Same as described for Pole P1.
 - c. Poles P2, P4 and P6: Same as described for Pole P1 except delete mounting bracket for speakers.
 - d. Pole 5: Provide pole similar to poles P2, P4, and P6 except provide (3) additional 770 watt fixtures to be aimed at field event area as indicated on Plans.
- D. Luminaire:
1. Luminaire Assembly:
 - a. The luminaire shall be listed to standard UL1598 by NVLAP laboratory (e.g. UL, CSA, ETL, etc.) and have a minimum ambient temperature rating of 40C. Manufacturer shall submit the Authorization to Mark (ATM) supplied by the applicable NVLAP as proof of safety listing and verification that final manufacturing point is within the United States.
 - b. Each floodlight shall be an assembly of LED assembly, driver, optics, and housing. Install with a common mounting assembly designed to allow each floodlight to be removed/replaced as a single unit.
 - c. Luminaire shall accept power at the mounting location provided by remote driver enclosure mounted lower on the pole.
 - d. Each floodlight shall have a Grade 304 stainless steel mounting yoke for attachment to the cross arms. The mounting yoke shall be a minimum thickness of 0.3125."
 - e. Shall be factory wired with dedicated wireless control module to provide dimming and on/off control as part of a complete wireless mesh network control system.
 - f. Individually labeled showing fixture number, tower designation and location on the structure.
 - g. Each luminaire shall be provided with a factory wired 3' length of 16/3 STOOW with a molded 3 pin connector to permit electrical attachment in the field without the need to hardwire the system.
- E. Remote Driver Enclosure::
1. The entire remote driver enclosure (ROE) shall be safety listed to UL1598. Cabinets that are not manufactured by the luminaire manufacturer, are assembled in the field by the contractor or are not listed to UL1598 as a complete system will not be accepted.
 2. Cabinet shall have a single incoming AC power landing to accept pole base electrical supply.

3. Each driver, fusing and all corresponding wiring shall be clearly labeled with driver ID # with permanent labels.
4. Provide a manual-operated, UL-listed, rotary type disconnect (3-pole) switch, fusing, & lugs, in a pre-wired weatherproof NEMA 4 Aluminum enclosure. Cover shall have full-length piano hinge. Provide enclosure pre-wired and complete, ready for installation on pole at job site.
5. Panel Mounting Height: Install on pole with bottom of enclosure at approximately 12 feet above finish grade. Pole shall be supplied with integrally welded mounting nuts. Floodlight wire harness exits disconnect and goes into pole through gasketed opening.
6. All electrical terminations for AC, DC out and wireless controls (dimming/12V DC) shall be made on DIN Rail mount style terminal blocks. Terminations with wire nuts, splices or WAGO style connections for these terminations will not be accepted.
7. Provide a ground lug for connecting grounding conductor run with pole feeder to pole.
8. Each RDE shall have a permanent, outdoor rated label on the bottom side of the enclosure with a unique ID number that is visible from the ground for installation validation and troubleshooting.
9. LED Driver Requirements
 - a. There shall be (1) driver per luminaire powering each luminaire with no more than a single pair of conductors (single channel) of DC power. Systems that power more than one luminaire per driver or utilize multiple drivers per luminaire will not be accepted.
 - b. To ensure uniform operation of the LED over a wide range of operating temperatures, the driver shall be constant current. The driver shall compensate for any voltage drop on conductors between the driver and luminaire automatically to ensure proper drive current to the LED array. Constant voltage or constant power solutions will not be accepted.
 - c. LED shall be operated at a drive current that is no more than 50% of the absolute maximum allowable drive current as specified within the LED manufacturer cut sheet for the diode used within the luminaire.
 - d. Driver shall come standard with 0-10V dimming, 12V auxiliary power and dim to off technology to allow the future addition of a wireless control system to turn off the luminaires without the need for contactors or relays.
 - e. Drivers shall be mounted to the enclosure with (4) hex head fasteners that do not need to be fully removed in order to remove the driver.
 - f. Each driver in the driver enclosure shall have a dedicated, extruded aluminum heat sinking housing to ensure consistent and reliable operation of the driver.
 - g. THD shall be no more than 20%.
 - h. Driver shall be UL Listed for Wet Location and be IP67 rated.
 - i. Power Factor >0.95

F. Optical Assembly:

1. General:
 - a. The fixture shall be of heavy-duty construction.
 - b. The LED housing shall be constructed of cast aluminum.
 - c. The optical assembly shall include an impact and thermal resistant tempered glass lens of no less than 0.15" thickness. Any material other than glass as the LED enclosure will not be accepted.
 - d. Each luminaire shall have a dedicated optical constructed of PMMA
 - e. LED boards shall be modular in design such that failure of any one LED board or driver will not reduce total luminaire output by more than 50%.
 - f. Wire to board electrical connections shall be made with poke-in style connectors only. Solder joints will not be accepted.

- g. Factory new LED modules and replacement modules shall be supplied by the manufacturer with factory applied graphite thermal interface material. This eliminates the need to apply thermal interface in the field and allows installation of a replacement module without having to clean the heat sink. Thermal grease or phase change material as the module TIM will not be accepted.

2. Glare Control:

- a. Glare and spill lighting is of a major concern on this project. As such, each luminaire shall be supplied with internal glare control that provides total glare cut off in all viewing angles (top, sides and bottom viewing angle of luminaire).
 - 1) Luminaires that offer only top visor control will not be accepted due to unacceptable glare on field.
- b. Glare control ribs shall extend from top side of LED optic a minimum of 13mm beyond the optic to provide full and complete glare cut off in all directions.
- c. Glare control material shall be of a matte black finish to reduce secondary reflected glare off the control ribs.
- d. Photometric reports and tests shall include glare control as specified.
- e. Luminaires that propose to use "TIR" optic technology as their sole method of glare mitigation will not be accepted. Unit must have "egg crate" style, matte black internal glare control.
- f. External methods of glare control (visors, louvers, baffles, etc.) are not effective at controlling glare in LED luminaires and will not be considered an acceptable alternative to a complete, internal glare control solution.

G. LED:

1. LED Characteristics:

- a. LED shall generate light that is 5000K CCT. CCT higher than 5000K will not be accepted.
- b. CRI shall be 70 CRI minimum; 70 CRI typical diodes will not be accepted.
- c. LED shall be "high power" in design and shall incorporate a base mounting material of either ceramic or aluminum. "Mid-power" LEDs like traditional "3030" or "5050" packages that utilize a plastic base material will not be accepted due to unacceptable long-term color shift, high lumen depreciation and extreme susceptibility to chemical attack in an outdoor environment.

2. Manufacturers: Nichia, Cree, Seoul.

H. Fixture Wiring in Pole:

- 1. Factory shall furnish multi-conductor cable harness of minimum No. 12 AWG designed for suspension inside the pole. Cable harness shall be designed to resist high abrasion and flexing. Cable harness shall be rated 600 V, 105C, and UL listed, and CSA classified. Standard building wire such as THWN is not acceptable. Furnish cable with appropriate suspension device.
- 2. Every cable shall include a grounding conductor.

2.4 MOUNTING STRUCTURES

A. Design Criteria:

- 1. Provide Sports Lighting Pole Systems including an anchor base tower, concrete foundation, and tubular service platforms with mounting provisions for luminaires.
- 2. Tower fabrication plant shall be AJSC Certified. Towers fabricated in a Non-AI SC production facility will not be accepted.

3. Minimum Basic Wind Speed: 130 mph 3 second gust
 4. Design Criteria: AASHTO LTS-6, non- fatigue
- B. Pole Shaft:
1. Each section of the pole shaft shall be of a single ply and be made from length of steel with no welded circumferential splices. Each slip joint shall be assembled in the field by telescoping the upper section over the lower section by a minimum lap of 1.5 times the largest inside diameter of the upper section. The pole shaft sections shall be high strength steel meeting the requirements of ASTM A572 Grade 65.
 2. Base weld shall be 100% penetration T-Weld
 - a. Socket type welds shall not be accepted
 - b. Base weld shall be 100% inspected via Ultrasonic or Radiographic methods by an AWS CWI (Certified Weld Inspector).
 3. The long seam shall have a minimum penetration of 60% along the length of the weld
 - a. 100% penetration of the seam weld shall be in following locations
 - 1). Female section of the slip joint+ 6"
 - 2). Bottom 6" of the base tube
 - b. Full penetration sections of the seam weld shall be 100% UT inspected
 4. Assembly: Factory-mark full telescoping points of all pole slip joints and match-mark all sections. Furnish pole assembly procedure with suggested equipment.
 5. The tower shall be inspected by an AWS (American Welding Society) CWI (Certified Welding Inspector) per the latest edition of AWS D1.1. Reports shall be submitted upon fabrication from an AWS CWI certifying the base welds have passed ultrasonic inspection per the latest edition of A WS D1. I
 6. Assembly: Factory-mark full telescoping points of all pole slip joints and match-mark all sections. Furnish pole assembly procedure with suggested equipment.
 7. Provide galvanized steel service steps at each pole, starting at 20 feet above grade up to maintenance cage.
- C. Hot Dip Galvanizing:
1. Assembled pole sections shall be individually hot-dipped galvanized in accordance with the requirements of ASTM A123. Each component must be completely coated in a single dip. No double dipping will be allowed. All miscellaneous hardware shall be galvanized per ASTM A153.
- D. Foundation:
1. The manufacturer self-repair a foundation design stamped by a NY Licensed Professional Engineer (PE).
- E. Tubular Service Platform Structural Strength – The platform, luminaire, and method of mounting shall be provided by the manufacturer such that it will structurally withstand 125 mph winds with 1.3 gust factor without misalignment or any damage to the crossarm or its components.
- F. Maintenance Service Cage:
1. Provide maintenance service cage and platform at each pole constructed of heavy gauge galvanized steel with platform and structure to encompass lighting fixture array on back of fixtures. Provide with expanded metal floor with hinged access door with stainless steel hardware to allow securing door from below.

2.5 WIRELESS CONTROLS

- A. General:
1. The wireless control system shall be wireless mesh technology. Each luminaire shall be provided with a factory integrated wireless control that is uniquely

identified for fixture number, location and aiming coordinates. Each fixture shall be individually addressable and controllable for full continuous dimming from 10% to 100% and shall be able to be completely switched off with dim-to-off technology via the control node. The main control unit shall be provided by the manufacturer within a NEMA4X non-metallic enclosure for mounting on an exterior wall by the contractor. The only wiring terminations the contractor should be required to make is 120V input to the control base station and connection of LAN cable to provide internet access to the controller. The control system shall be commercially available such that future luminaires purchased by the end user from any manufacturer can be optioned with either an internal controller or 7 PIN dimming receptacle for integration to the system. The entire wireless control system shall be provided and warranted by the sports lighting manufacturer. All service, programming and training shall be provided by the sports lighting manufacturer and not by a 3rd party.

- B. Central Base Station (Main Controller):
1. Contained within NEMA 4X non-metallic enclosure
 2. Incorporates cellular SIM card such that that manufacturer to gain access to the system with or without LAN access for programming, training, and troubleshooting
 3. Provide five push buttons that are factory programmed to user identified scenes. Example scene summary shown below:
 - a. 100% On
 - b. 50% Dim
 - c. Security
 - d. Open
 - e. Open
 4. The control system shall be able to be controlled via use of the push buttons, wireless control apps for smart phone or tablet or via an internet portal.
 5. Shall have the capacity to control up to 500 luminaires to provide the end user the ability to expand the control system in the future.
- C. Wireless Control Node:
1. Contained internal of each luminaire
 2. To ensure long term reliability of the control system, the control node shall not receive power from the AC mains. The Controller shall receive 12V power directly from one of the LED drivers in the luminaire.
 3. The Controller shall provide standard 0-10V dimming commands to the drivers within the luminaire.
 4. The control node shall be able to be serviced and replaced within the luminaire without removal of the luminaire from the tower.
 5. The manufacturer is responsible for identifying and locating all luminaires on the job site such that they can remotely identify and control each luminaire.
- D. Communication Costs:
1. The system shall provide wireless control and monitoring via LAN connection provided by the end user. Any additional costs to operate the control system for a period of 5 years including software costs shall be paid for by the manufacturer.
- E. Training:
1. Sports Lighting Manufacturer shall provide a training session for the end user after installation and commissioning of the system. Training shall discuss programming, operation and use of the control system. Manufacturer shall provide a minimum of 8 hours of custom programming time if required to ensure the 5 control scenes are to the liking of the end user. Each control scene shall be designed to provide adequate and safe illuminate of the sports fields while minimizing energy consumption on the job site. Each scene shall be achieved via selectively dimming or switching on/off luminaire across the site.

- F. Commissioning and Training:
 - 1. One-day controls engineering calibration and training visit shall be included in manufacturer proposal.
 - 2. Controls engineer shall ensure the system is installed and operating correctly and ensure control nodes are operating on latest firmware.
 - 3. Initial programming, grouping, and scheduling of system shall be provided by control engineer both on site and after the visit.
 - 4. Contractor shall ensure controls engineer has complete and unrestricted access to the lighting system and controls. If the controls engineer is required to stay beyond one working day due to site conditions or added scope, the contractor shall pay for added costs.

2.6 MISCELLANEOUS

- A. Refer to other Division 26 Sections for:
 - 1. Conduit.
 - 2. Conductors.
 - 3. Lighting contactors.
 - 4. Weatherproof enclosures.
 - 5. Miscellaneous electrical items.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Complete installation shall conform to the National Electric Code and system manufacturer's instructions.
- B. Location: As required by manufacturer's design. Division 26 Contractor shall be responsible for site layout of each assembly.
- C. Mounting: In strict accordance with manufacturer's instructions.
- D. Grounding:
 - 1. According to the requirements of the NEC.
 - 2. Bond pole to system equipment ground and external ground rod.
- E. Balance loads at each assembly so that each phase of the feeder circuit is plus or minus 5 percent among all phases.

3.2 CARE OF ASSEMBLIES

- A. Perform an on-site inspection and accept delivery of poles and accessories prior to unloading from transportation vehicle. Acceptance shall imply that pole and accessories are free from defective or damaged components.
- B. If defective or damaged components are found at on-site inspection, bring to manufacturer's attention so that manufacturer can replace with new, with no additional cost added to the Contract.
- C. Remove all broken glassware or fixtures damaged, and replace with new before final acceptance, with no additional cost added to the Contract.
- D. No allowance made for breakage or theft before final acceptance.
- E. Immediately prior to acceptance, clean all poles, fixtures, accessories. Replace all burned-out lamps, defective ballasts.

3.3 TESTING/ADJUSTING

- A. All luminaires shall be operating and properly aimed.
- B. Coordinate with the manufacturer's representative the testing of respective equipment for proper operation after installation. Test lighting fixtures, branch circuitry and circuit load balance. Lighting fixtures shall be tested as a complete system.
- C. The system shall be turned on at least 60 minutes prior to testing to ensure the system has reached operating temperature.
- D. Adjust each light fixture on each lighting fixture assembly after all assemblies are set in their final position. Adjustments shall be made until submitted lighting levels have been met. Testing and adjusting for each field shall be as follows:
 - 1. Pie-plate field (witnessed by Owner's Representative).
 - 2. Have factory representative take footcandle reading at each coordinate.
 - 3. Adjust light fixtures as required until submitted lighting levels have been met.
 - 4. Photometer shall be of good quality and accuracy.
- E. Tests shall be taken when the air is clear and recently calibrated. Photometer shall be designed to measure sports lighting applications with multiple light fixtures shining on the meter. Extraneous light is at a minimum.
- F. Field-measurements method shall be in accordance with Annex B of IES RP-6.
- G. Include in Bid an additional 24 premium-rate man hours to return to site to readjust light fixtures after the first light readings are taken by factory representative.

END OF SECTION

SECTION 26 56 00
EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Exterior luminaires with LEDs and drivers.
 - 2. Poles and accessories.

1.2 DEFINITIONS

- A. DLC: DesignLights Consortium.
- B. THD: Total harmonic distortion.
- C. EPA: Effective projected area.
- D. HPF: High power factor.
- E. LED: Light-emitting diode.
- F. Luminaire: Complete lighting fixture, including driver housing.
- G. Pole: Luminaire support structure, including tower used for large area illumination.

1.3 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

- A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-4.
- B. Live Load: Single load of 500 lbf, distributed as stated in AASHTO LTS-4.
- C. Ice Load: Load of 3 lbf/sq. ft., applied as stated in AASHTO LTS-4.
- D. Wind Load: Pressure of wind on pole and luminaire, calculated and applied as stated in AASHTO LTS-4.
 - 1. Wind speed for calculating wind load for poles 50 feet or less in height is 110 mph.

1.4 SUBMITTALS

- A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
 - 2. Details of attaching luminaires and accessories.
 - 3. Details of installation and construction.
 - 4. Luminaire materials.
 - 5. Photometric data based on laboratory tests of each luminaire type, complete with indicated LEDs, drivers, and accessories.
 - 6. Drivers, including energy-efficiency data.
 - 7. LEDs, including life, output, and energy-efficiency data.
 - 8. Materials, dimensions, and finishes of poles.

9. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
 10. Anchor bolts for poles.
 11. Caulk color samples for building-mounted fixtures.
- B. Shop Drawings:
1. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
- C. Operation and Maintenance Data: For luminaires and poles to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100.
- C. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- B. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

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. Basis-of-Design Product: The design of each item of exterior luminaire and its support is based on the product named. Subject to compliance with requirements, provide either the named product or approved equal by one of the other manufacturers specified.

2.2 LUMINAIRES, GENERAL REQUIREMENTS

- A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
- B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use.

- F. 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. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.
- G. Exposed Hardware Material: Stainless steel.
- H. Polycarbonate Shields: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- I. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
- J. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- K. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

2.3 DRIVERS FOR OUTDOOR LED FIXTURES

- A. Comply with ANSI and UL and coordinated with LED source/modules to deliver maximum output and maximum life. Include the following features, unless otherwise indicated:
 - 1. Driver Circuit: HPF type.
 - 2. Minimum Starting Temperature: Minus 40 deg C.
 - 3. Normal Ambient Operating Temperature: 104 deg F.
 - 4. Five-year full warranty.
 - 5. Step dimming and 0- to 10-V dimming type as called for.
 - 6. Maximum THD: 20 percent.
- B. Driver to be capable of providing end-of-life signal for easy maintenance.

2.4 POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS

- A. Structural Characteristics: Comply with AASHTO LTS-4.
- B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.
- C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
 - 1. Materials: Shall not cause galvanic action at contact points.
 - 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dipped galvanized after fabrication, unless stainless-steel items are indicated.
 - 3. Anchor-Bolt Template: Plywood or steel.
- D. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork as indicated on Drawings.

2.5 ALUMINUM POLES

- A. Poles: ASTM B 209, 5052-H34 marine sheet alloy with access handhold in pole wall.
 - 1. Shape: Square, straight.
 - 2. Mounting Provisions: Butt flange for bolted mounting on foundation.
- B. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through hand hole.
- C. Finish:
 - 1. Color: Powder-coat finish.

2.6 POLE ACCESSORIES

- A. Base Covers: Manufacturers' standard metal units, arranged to cover pole's mounting bolts and nuts. Finish same as pole.

2.7 REQUIREMENTS FOR INDIVIDUAL LIGHTING FIXTURES

- A. Fixture Types/Schedule:
 - 1. Type EA:
 - a. Fixture:
 - 1) Description: LED luminaire, pole-mounted with one-piece, die-cast aluminum housing of 30-inch-long by 15-inch-wide by 8-inch-deep nominal size with die-cast aluminum heat sink; die-cast aluminum upswept arm mount for pole attachment; stainless-steel hardware; one-piece die-cast aluminum lens frame with 1-inch minimum thickness around the gasket flange for rigidity. Optic chamber and separate driver housing constructed to IP 65. High-impact, injection-molded, clear, UV-stabilized polycarbonate lens. Provide Type III light distribution with the ability to rotate module in the field to vary light distribution patterns. Lighting array of LEDs rated 4000-degree temperature (color), which produces 21,000 absolute lumens at 145 watts. High-efficiency driver to maintain constant current flow to LEDs. High-power factor and RoHS-compliant driver rated 120/277 V, starting at -30 deg F. DLC- and Dark Sky-Listed, with rating of 300,000 hours at 70 percent lumen maintenance (L70). Provide all stainless-steel mounting hardware. Provide integral area motion sensor to drop light output and power to 50 percent if no motion is detected over a programmed period of time. Once motion is detected, the lights return to 100 percent output. Provide 2.5-mil-thick, powder-coat paint finish in standard color (minimum 7 available) as selected by Architect at time of submittal, rated for 2,500 salt-spray endurance test for both luminaire and pole. UL-listed for wet locations. Provide polycarbonate shield to protect luminaire. Provide pole as specified below. Submit luminaire sample.
 - 2) Basis-of-Design Product: Current/Beacon "Viper" series or approved equal by one of the following:
 - a) McGraw/Edison "Galeon" Series.
 - b) Gardco "Ecoform."

- b. Pole:
 - 1) Description: Round, tapered aluminum shaft from seamless extruded-aluminum tube made of Type 6063-T4 aluminum alloy with cast base flange welded to the bottom of the pole. Provide galvanized anchor bolts, anchor-bolt/base cover, shaft cap, hardware and anchor-bolt circle template included. Anchor bolt/base cover finish and material to match pole. Provide hand hole 18 inches above base with internal grounding on back. 25-foot pole height, EPA 10.8 at 100 mph, 8-inch-diameter at base, 4.5-inch-diameter at top, by 25-foot-long shaft dimensions with finish to match luminaire, 0.188-inch pole wall thickness.
 - 2) Basis-of-Design Product: Valmont #2408 Series or approved equal.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

- A. Install LEDs and adjust aiming at each luminaire.
- B. Fasten luminaire to specified structural supports.
- C. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources.
- D. Exterior Lighting Fixtures:
 - 1. Location: As indicated on Contract Drawings. Division 26 Contractor shall be responsible for site layout. Exact horizontal and vertical position shall be verified prior to roughing.
 - 2. Mounting: In accordance with manufacturer's instructions. All fastening devices and hardware shall be stainless steel.
 - 3. Ground each luminaire to green equipment ground conductor.
 - 4. Verify the exact locations of exterior fixtures, pole, and building mounted with Architect prior to roughing.
 - 5. Mount street and parking area pole centerlines 7' from edge of pavement unless otherwise directed.
 - 6. Mount walk light pole centerlines 4' from edge of walk unless otherwise directed.
 - 7. Provide 10' ground rod at each pole. Extend No. 2 AWG copper conductor from pole or fixture ground lug to ground rod. Install ground rod 6" below grade. Do not cover until inspected by Owner's Representative. Also, bond pole to ground conductor extended with branch circuit serving luminaire.
 - 8. Install pole with hand hole facing away from street, parking, or walkway, unless position of luminaire is affected.
 - 9. Concrete bases shall be set on 12" layer of compacted gravel; backfill around base shall be gravel placed in 12" compacted layers.

3.2 POLE INSTALLATION

- A. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features, unless otherwise indicated on Drawings:
 - 1. Fire Hydrants and Storm Drainage Piping: 60 inches.
 - 2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet.
 - 3. Trees: 15 feet.
- B. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer.

- C. Foundation-Mounted Poles: Mount pole with leveling nuts and tighten top nuts to torque level recommended by pole manufacturer.
- D. Raise and set poles using web fabric slings (not chain or cable).

3.3 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Division 26 Section "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.4 GROUNDING

- A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
 - 1. Install grounding electrode for each pole, unless otherwise indicated.
 - 2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

3.5 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.
 - 1. Verify operation of photoelectric controls.

END OF SECTION

SECTION 27 14 50

DATA NETWORK SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Division 26 Section "General Requirements for Electrical" applies to the Work of this Section.

1.2 SUMMARY

- A. Section includes criteria required for a complete computer data distribution system at each of the facilities indicated in the Contract Documents.
- B. Related Sections:
 - 1. Division 26 Section "Raceways and Boxes for Electrical Systems."
- C. Scope of Work:
 - 1. Upgrade and provide additions/revisions at each existing data network system serving each building.
 - 2. Provide all necessary computer data distribution system equipment, wiring and other associated devices, components, and accessories as required for the system specified herein and as indicated in the Contract Drawings.
 - 3. Utilize existing main distribution frame ("MDF") and intermediate distribution frames ("IDFs") as indicated on the Contract Documents. Each IDF is linked to the MDF via cables in a star configuration. Provide horizontal copper cabling and data cable outlets throughout the building as called for. Provide horizontal copper and/or cabling connected and extended from an IDF to each data/workstation jack.
 - 4. Provide Category 6 data outlets and Category 6, unshielded, twisted-pair, copper cables to Category 6 data outlets (RJ45) as called for.
 - 5. Provide Category 6 data outlets for the wireless data system outlets and Category 6, twisted pair, copper cables to Category 6 wireless outlets as called for.

1.3 REFERENCES

- A. Design, manufacture, test, and install data distribution systems per manufacturer's requirements and in accordance with NFPA 70 (National Electrical Code), state codes, local codes, requirements of authorities having jurisdiction, and particularly the following ANSI/TIA/EIA standards:
 - 1. ANSI/TIA/EIA-568.0-D and Addenda: Generic Telecommunications Cabling for Customer Premises
 - 2. ANSI/TIA/EIA-568.1-D and Addenda: Commercial Building Telecommunications Cabling Standard
 - 3. ANSI/TIA/EIA-568-C.2 and Addenda: Balanced Twisted-Pair Telecommunication Cabling and Components Standard
 - 4. ANSI/TIA/EIA-568-C.3 and Addenda: Balanced Optical Fiber Cabling Components Standard
 - 5. ANSI/TIA/EIA-569-D and Addenda: Commercial Building Standard for Telecommunications Pathways and Spaces.
 - 6. ANSI/TIA/EIA-569-A: Optical Fiber Cable Color-Coding.
 - 7. ANSI/TIA/EIA-606-B and Addenda: The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
 - 8. ANSI/TIA/EIA-607-C and Addenda: Commercial Building Grounding and Bonding Requirements for Telecommunications.

9. ANSI/TIA/EIA-758-B: Customer-Owned Outside Plant Telecommunications Cabling Standard.
10. ANSI/TIA/EIA-758-1: Addendum No. 1 to TIA/EIA-758 Customer-Owned Outside Plant Telecommunications Cabling Standard.
11. TIA/EIA TSB-67: Transmission Performance Specifications for Field-testing of Unshielded Twisted-Pair Cabling Systems.
12. TIA/EIA TSB-72: Centralized Optical Fiber Cabling Guidelines. All items of equipment shall be UL-listed or UL-recognized.
13. ANSI/TIA/EIA-526-14A: Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant.
14. ANSI/TIA/EIA-942 and Addenda: Telecommunications Infrastructure Standards for Data Centers.

1.4 SUBMITTALS

- A. Submit applicable manufacturer's literature, Shop Drawings, and data to confirm the conformance to the Contract Documents for the following:
 1. Data conductors, outlets, and cover plates.
 2. Main and intermediate distribution frames, and include layout for each location and details of jacks, termination devices, and accessories.
- B. Provide full and complete riser wiring diagram of all additions and revisions to the data network.
- C. Submittals shall also include but not be limited to the following:
 1. Complete materials list.
 2. List of similar installations completed in the last 3 years.
 3. A sample of test reports and certification procedures for Category 6 and connections.
 4. Manufacturer's catalog sheets, specifications, and local factory representative.
 5. Name, address, and telephone number of nearest service organization.
 6. Warranty and service information.
 7. Equipment sign-off forms (as required) stating the Owner has accepted delivery of specified equipment.
 8. System training sign-off sheets stating that Owner has received the specified training required.
 9. Operating and maintenance manuals, including:
 - a. Plan drawings indicating locations and identification of each outlet, closet, and backbone cable routing.
 - b. Approved Submittals.
 - c. Warranty information and documentation.
 - d. Network test report printouts and diskettes.
- D. As-Built Drawings:
 1. Three sets of as-built Contract Drawing shall be delivered to the Owner within 4 weeks of acceptance of Project by the Owner. A set of as-built drawings shall be provided to the Owner in magnetic media form (CD/DVD) and utilizing CAD software that is acceptable to the Owner. The magnetic media shall be delivered to the Owner within 6 weeks of acceptance of Project by Owner. Provide as-built drawings with locations and cable paths.
- E. Project Record Drawings:
 1. Submit at conclusion of the Project and include:
 - a. Approved Shop Drawings.
 - b. Plan Contract Drawings indicating locations and identification of work area outlets, nodes, closets (MDF and IDFs), and backbone (riser) cable runs.
 - c. Cross-connect schedules including entrance point, main cross-connects, intermediate cross-connects, and horizontal cross-connects.

- d. Labeling and administration documentation.
 - e. Warranty documents for equipment.
 - f. Copper certification test result printouts and diskettes.
 - g. Optical fiber power meter/light source test results.
 - h. Operation and maintenance manuals.
- F. Test Reports--General:
- 1. Provide a complete system test report (bound) of the additions and revisions to the existing data network. After the report is acceptable, upon Engineer's review, the report shall be included in the Division 27 O&M manual. Also, the acceptable test report shall be submitted to the Construction Manager on compact disk in PDF format.
 - 2. Refer to Article 3.8 of this Section for additional information.
- G. The Engineer's approval of Shop Drawings, product data, and samples shall not relieve the Division 27 Contractor of responsibility for errors or omissions in Shop Drawings, product data, and samples.

1.5 MAINTENANCE-MATERIAL SUBMITTALS

- A. Furnish the following spare equipment and parts:
- 1. 20 Category 6 outlets as specified.
 - 2. 2,000 feet of horizontal Category 6 cable as specified.
 - 3. 50 Category 6 patch cables as 3-foot lengths.

1.6 SYSTEM WARRANTY AND CERTIFICATION

- A. All products shall include a minimum of one-year parts replacement warranty. Warranty shall begin when system is formally accepted by Owner in writing.
- B. Equipment in need of repair shall be replaced by the certified manufacturer's representative by the next business day.
- C. Data cabling system shall be certified by the system component manufacturer and shall be provided with a 15-year end-user warranty from the manufacturer.
- D. Manufacturer/Contractor shall, prior to completion of Project, provide the Owner with a proposal to provide training for the Owner's personnel to enable the Owner's personnel to be properly certified to design, install, and test future data cable system modifications. Training of Owner's personnel will allow the Owner to perform future moves, additions, and changes to the data cable system and keep intact and valid the manufacturer's 15-year end-user warranty and certification.
- E. All data-system cable components, panels and enclosures, premises wiring-system equipment racks, Category 6 system components including equipment racks, patch panels, horizontal distribution cable, data outlets, patch cords, etc., must be warranted by a single manufacturer. The warranty must certify the components to be in compliance with TIA/EIA TSB-67 transmission performance specifications for field testing of unshielded twisted-pair cabling systems.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
- 1. The installer for this Project must be certified by the manufacturer of the products, adhere to the engineering, installation, and testing procedures, and utilize the authorized manufacturer components and distribution channels in provisioning this Project.
 - 2. Installers, who do not meet qualifications listed, will not be permitted to perform any installation work.

- a. Installer shall have on staff for the previous 12 months prior to the bid date a Registered Communications Distribution Designer. Submit a copy of current Registration information and date of original certification for RCDD.
 - b. Installers shall have minimum 5 years' experience with computer network installations.
 - c. Installer shall provide to Architect/ Engineer, a reference list of 10 recently completed projects of similar size and scope. Reference list shall include detailed description of installers actual work responsibilities. Reference list shall also include contact persons and telephone number for each project.
- B. If Division 27 Contractor cannot meet "Installer Qualifications" described above, respective Division 27 Contractor must hire a subcontractor that meets stated installer's qualifications.
 - C. Division 27 Contractor shall have worked satisfactorily for a minimum of five years on data network systems of this type and size.
 - D. Upon request by the Engineer, furnish a list of references with specific information regarding type of project and involvement in providing of equipment and systems.
 - E. Equipment and materials of the type, for which there are independent standard testing requirements, listings, and labels, shall be listed and labeled by the independent testing laboratory.
 - F. All equipment and cabling shall be EIA/TIA-compliant for copper facilities.

1.8 PRODUCT HANDLING

- A. Protection: Use all means necessary to protect materials of this Project before, during, and after installation and to protect installed work and materials of all other trades.
- B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Engineer and at no additional cost to the Owner.

1.9 COORDINATION

- A. Use all means necessary to coordinate with other trades and ensure that proper and adequate provision is made in the work of other Sections to accommodate installations of the work of this Section.

PART 2 - PRODUCTS

2.1 FABRICATION

- A. Fabricate custom-made equipment with careful consideration given to aesthetic, technical, and functional aspects of equipment and its installation.

2.2 CATEGORY 6 CABLES, CONNECTORS, AND TERMINAL EQUIPMENT

- A. Unshielded Twisted Pair ("UTP"), Category 6:
 - 1. Basis-of-Design Product: Provide Superior Essex "DataGain 66" series or approved equal by one of the following:
 - a. Berk-Tek "LANmark-1000" series.
 - b. CommScope "7504" series.
 - c. TE Connectivity "620P."

2. Horizontal cable shall be No. 23 AWG, 4-pair UTP, UL/NEC, CMP rated with a blue plenum-rated PVC jacket. For data workstation outlets, a green plenum-rated jacket for wireless network outlets and orange plenum-rated jacket for surveillance/camera outlets. This cable shall be used throughout the Project in all areas required and indicated for data network, wireless network, and camera/surveillance outlets.
3. Cable is to be Category 6-rated with the following parameters.
4. Transmission characteristics shall include:
 - a. DC resistance of any conductor shall not exceed 9.38 ohms per 100 m maximum at 20 deg C. Measured in accordance with ASTM D 4566.
 - b. Mutual capacitance of any pair at 1 kHz for 100-m cable shall not exceed 4.4 NF.
 - c. DC resistance unbalance between any two conductors of any pair shall not exceed 3 percent when measured at or corrected to 20 deg C in accordance with ASTM D 4566.
 - d. Capacitance unbalance to ground at 1 kHz of any pair shall not exceed 330 pF per 100 m.
 - e. Structural return loss (SRL) swept measurement for 100 m or longer shall meet or exceed the following:

FREQUENCY (MHz)	1.0	4.0	10.0	16.0	20.0	31.25	62.5	100	155	200	250	300	400
Max. SRL (dB)	26.0	26.0	26.0	26.0	26.0	25.0	23.5	22.5	21.6	21.0	20.5	19.8	19.0

- f. The maximum insertion loss (IL) of any pair shall be less than the following:

FREQUENCY (MHz)	1.0	4.0	10.0	16.0	20.0	31.25	62.5	100	200	250	400
Max. Attenuation (dB)	2.0	3.8	5.9	7.5	8.4	10.6	15.3	19.7	28.8	32.6	42.7

- g. The near-end crosstalk (NEXT) coupling loss between pairs in a cable shall be greater than or equal to the following:

FREQUENCY (MHz)	1.0	4.0	10.0	16.0	20.0	31.25	62.5	100	200	250	400
NEXT Loss Worst Pair (dB)	79.3	70.3	64.3	61.2	59.8	56.9	52.4	49.3	44.8	43.3	36.3

- h. The power-sum, near-end crosstalk (PSNEXT) loss at 20 deg C plus 3 degrees (68 deg F plus 5.5 degrees) between pairs in a cable for a length 100 m (328 feet) shall be greater than or equal to the following:

FREQUENCY (MHz)	1.0	4.0	10.0	16.0	20.0	31.25	62.5	100	200	250	400
PSNEXT Loss Worst Pair (dB)	77.3	68.3	62.3	59.2	57.8	54.9	50.4	47.3	42.8	41.3	34.3

- i. The equal-level, far-end crosstalk (ELFEXT) loss at 20 deg C plus 3 degrees (68 deg F plus 5.5 degrees) between pairs in a cable for a length of 100 m (328 feet) shall be greater than or equal to the following:

FREQUENCY (MHz)	1.0	4.0	10.0	16.0	20.0	31.25	62.5	100	200	250	400
ELFEXT Loss Worst Pair (dB)	72.7	60.7	52.7	48.6	46.7	42.8	36.8	32.7	26.7	24.7	17.8

- j. The power-sum, equal-level, far-end crosstalk (PS-ELFEXT) loss at 20 deg C plus 3 degrees (68 deg F plus 5.5 degrees) between pairs in a cable for a length of 100 m (328 feet) shall be greater than or equal to the following:

FREQUENCY (MHz)	1.0	4.0	10.0	16.0	20.0	31.25	62.5	100	200	250	400
PS-ELFEXT Loss Worst Pair (dB)	69.3	57.8	49.8	45.7	43.8	39.9	33.9	29.8	23.8	21.8	12.8

- k. The return loss (RL) at 20 deg C plus 3 degrees (68 deg F plus 5.5 degrees) between pairs in a cable for a length of 100 m (328 feet) shall be greater than or equal to the following:

FREQUENCY (MHz)	1.0	4.0	10.0	16.0	20.0	31.25	62.5	100	200	250	400
Min. RL (dB)	20.0	23.0	25.0	25.0	25.0	23.6	21.5	20.1	18.0	17.3	15.9

B. Outlet Faceplates:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Ortronics "Angled Series II" faceplates or approved equal by one of the following:
 - a. TE Connectivity "SL" series.
 - b. CommScope "Systimax" series.
 - c. Leviton "eXtreme 6+."
2. Work-area faceplates shall be compatible with modular jack inserts iconable and match electrical devices in color. Faceplates shall have a covered designation strips that allow identifying each jack. Provide full frame faceplates that accept multiple combinations of data outlets of both fiber and Category 6 type. Provide inserts that orient outlets to accept four jack inserts at 45-degree exit.
3. Refer to Contract Drawings for exact quantity, number of ports required and location of faceplates.
4. Blanks shall be installed to all unused openings.

C. Category 6 Jacks and Inserts:

1. Basis-of-Design Product: Provide Ortronics "KT2J" series or approved equal by one of the following:
 - a. TE Connectivity "SL" series.
 - b. CommScope "Systimax" series.
 - c. Leviton "eXtreme 6+."
2. Voice/data jacks shall be 8-position, 8-conductor (8P8C) modular jacks and shall be Category 6 performance, as defined by the references in this Section, including ANSI/TIA-568-C.2. All pair combinations must be considered, with the worst-case measurement being the basis for compliance.
3. Modular-jack performance shall be third-party-verified by a nationally recognized, independent testing laboratory.
4. The modular jack shall use dual-reactance modular contact array.
5. The modular jack shall have low-emission IDC contacts.
6. The modular jack shall use standard termination practice using 110 impact tool; or if using the Ortronics "KT2J," the jack shall have a lacing cap.
7. The modular jack shall be center-tuned to Category 6 test specifications.

D. Category 6 Modular Patch Panels:

1. Basis-of-Design Product: Provide Ortronics "SPKS" series or approved equal by one of the following:
 - a. TE Connectivity "SL."
 - b. CommScope "Systimax" series.
 - c. Leviton "eXtreme 6+."
2. All patch panels shall meet EIA/TIA 568C, Category 6 specifications.
3. Cables shall be neatly dressed to patch panels.

4. Cable management rings will be used as required for dressing cables.
5. TIA-568-B termination procedures shall be observed verify with the Owner.
6. All four-pair must be terminated.
7. A horizontal wire management panel shall be installed below each patch panel and/or below the last patch panel installed to rack.
8. Cable troughs shall be installed at the top and bottom of each equipment rack.
9. Vertical wire management rings shall be installed to both sides of racks, five per side.
10. Patch panels shall be compatible with a 19-inch equipment rack and wired to EIA/TIA 568C. Patch panels shall accept individual bezels. The front of each module shall be capable of accepting 9- to 12-mm labels. Each port shall be capable of accepting an icon to indicate its function. Patch panels shall terminate the building cabling on 110-style insulation displacement connectors. Patch panels shall provide power sum Category 6 Near-end Cross Talk (NEXT) performance equal to the cable specifications, in addition to all other standard Category 6-performance characteristics.

2.3 EQUIPMENT RACKS/CABINETS

- A. MDFs and IDFs:
 1. Equipment Racks:
 - a. Basis-of-Design Product: Provide Ortronics "OR-19-84-T4SDA2132" or approved equal by one of the following:
 - 1) Chadsworth.
 - 2) TE Connectivity.
 - 3) Great Lakes.
 - b. Utilize existing equipment racks at MDF and IDF locations. Provide additional data racks as required.
 - c. Distribution Frames: Freestanding, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported, 84 inches high with adjustable dual-equipment, 4-post racks.
 - d. Dimensions: 84 inches high x 20.19 inches wide x 21 to 32 inches deep, 45RU.
 - e. Module Dimensions: Width compatible with EIA 310 standard, 19-inch panel mounting.
 - f. Finish: Manufacturer's standard, baked-polyester powder coat.
 - g. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug. Provide with a 19-inch rack. Mount 6-outlet rear power-strip surge suppressor, 15 Amp, with a 15-foot power cord.
 2. Interior Equipment Cabinets:
 - a. Basis-of-Design Product: Provide Ortronics "OR-MMW192426P-B" or approved equal by one of the following:
 - 1) Hoffman.
 - 2) Great Lakes.
 - b. Interior equipment cabinets shall be 36" wall-mounted, lockable cabinet with glass door to house rack for data equipment. Wall-mounted cabinet with tapped rails and hinged front door and hinged middle section from back enclosure with power strip and two 4"-diameter fan assemblies. Provide black color. Provide equipment cabinet as called for on the Contract Documents.
 - c. Dimensions: 19U, 24 inches wide x 26 inches deep by 36 inches high.
 3. Cable Management for Equipment Frames/Cabinets:
 - a. Metal, with integral wire retaining fingers.
 - b. Baked-polyester powder coat finish.
 - c. Vertical cable management panels shall have front and rear channels, with covers.

- 1) Basis-of-Design Product: Provide Ortronics "DVMS706" or approved equal.
 - d. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.
 - 1) Basis-of-Design Product: Provide Ortronics "60400057" or approved equal.
 - e. Provide Velcro-type cable wraps as required to secure/organize cables.
 - 4. Consult the Owner and Construction Manager to coordinate exact location of equipment.
- B. Surface Metal Raceway, Conduit Stubs, Wall Outlets:**
- 1. General: As described in Division 26 Section "Raceways and Boxes for Electrical Systems."
 - 2. Surface Metal Raceway:
 - a. At existing construction, provide surface metal raceway as indicated on the Contract Documents.
 - 3. Conduit Stubs:
 - a. General: Provide conduit from each data (copper and/or fiber) outlet and/or 2-section surface raceway and extend to accessible corridor ceiling space; size as indicated on Contract Drawings.
 - 4. Wall Outlets:
 - a. Wall box (at new construction): Flush, 4 inches x 4 inches x 2-1/8-inch-deep box with single-gang plaster ring.
- C. MDF and IDF Wiring Closets:**
- 1. All horizontal and backbone cables shall enter the wiring closets via 3-inch-diameter conduit sleeves. All penetrations to the wiring closet shall be sleeved in conduit with appropriate fittings. Provide a minimum of one additional 3-inch sleeves shall be provided for horizontal cables at each closet.
 - 2. Communication cable shall enter at the top of each equipment rack.
- D. Wall and Floor Penetrations:**
- 1. Provide a minimum of one 3-inch sleeve at all walls above accessible corridor ceilings to allow routing of cables.

2.4 POWER STRIPS

- A. Power Strips: Comply with UL 1363.**
- 1. Rack mounting.
 - 2. Six 15-A, 120-V ac, NEMA WD 6, Configuration 5-15R 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. Close-coupled, direct plug-in line cord.
 - 7. Rocker-type, on-off switch, illuminated when in on position.
 - 8. Peak Single-Impulse Surge Current Rating: 13 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 Division 26 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 with 9/32-inch holes spaced 1-1/8 inches apart.
 3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.
- C. Comply with ANSI-J-STD-607-C.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with requirements and other conditions affecting the performance of the data distribution system work. Do not proceed until unsatisfactory conditions have been corrected.

3.2 CONTINUITY OF SERVICES

- A. Take no action that will interfere with, or interrupt, existing building services unless previous arrangements have been made with the Construction Manager. Arrange the work to minimize shutdown time.
- B. Owner's personnel will perform shutdown of operating systems. Give three days' advance notice for systems shutdown.
- C. Should services be inadvertently interrupted, immediately furnish labor, including overtime, material, and equipment necessary for prompt restoration of interrupted service.

3.3 CABLE ROUTING AND INSTALLATION REQUIREMENTS

- A. Cable Pathway for Category 6 Cables:
1. Extension of all data cables shall be within raceway, conduit, cable tray, back boxes, or other designated cable delivery system.
 2. Open wiring is permitted above accessible corridor ceilings with removable tiles and/or access panels. Provide raceways, boxes, etc., to house cabling from workstation outlets to cable tray above accessible corridor ceilings as detailed on the Drawings.
 3. Within cable tray above accessible corridor ceilings (suspended), bundle, in bundles of 50 or less, horizontal wiring with nylon-type cable wraps held with Velcro. Bound cables snug but not deforming the cable geometry. Cable bundles shall be supported via cable tray or "J" hooks attached independently to the building structure and framework at a maximum of 5-ft intervals. Plenum-rated cable ties will be used in all appropriate areas. Adhere to the manufacturers' requirements for bending radius and pulling tension of all data cables.
 4. Cables shall not be attached to lift out ceiling grid supports or laid directly on the ceiling grid. Support cables a minimum of 12 inches above the ceiling.
 5. Cables shall not be attached to or supported by conduit, HVAC/plumbing piping, HVAC ducts, systems, or any environmental sensor located in the ceiling air space.
- B. Cabling: All communications cabling used throughout this Project shall comply with the requirements as outlined in NEC Articles 725, 760, 770, and 800 and the appropriate local codes. All copper cabling shall bear CMP (plenum-rated) markings.

3.4 INSTALLATION

- A. Install the work of this Contract in strict accordance with the recommendation of the manufacturers as approved by the Engineer, anchoring all components firmly into

position for long life under hard use. All wall- and ceiling-mounted equipment shall be installed to provide a minimum safety factor of three times the weight of the equipment.

- B. System equipment locations shown on the Contract Drawings are approximate. Verify exact locations in the field and coordinate these with the Engineer.
- C. Labels must withstand the performance requirements of UL 969 as outlined in the TIA standard. Actual room numbers are to be used in labeling. These room numbers may not agree with those indicated on the Contract Drawings. Coordinate all labeling and numbering with the Engineer, Owner, or Construction Manager.
- D. Remove and reinstall existing ceiling tiles for the work of this Contract, and replace damaged tiles.
- E. Install materials and equipment in accordance with applicable standards, codes, requirements, and recommendations of national, state, and local authorities having jurisdiction, and NEC and with manufacturer's printed instructions.
- F. Adhere to manufacturer's published specifications for pulling tension, minimum bend radii, and sidewall pressure when installing cables.
- G. Each cable run between an outlet and the corresponding MDF/IDF shall be continuous without any splices or joints.
- H. The length of each horizontal Category 6 cable run between an outlet and the corresponding MDF/IDF shall not exceed 275 ft.
- I. All equipment racks shall be secured to the floor according to TIA/EIA standards. Ground data racks in accordance with ANSI/TIA/EIA-607.
- J. Equipment racks shall be sized to allow for sufficient rack space for Owner's network equipment that connects directly to the patch panels.
- K. Installation shall conform to the following basic guidelines:
 - 1. Use of approved wire, cable, and wiring devices.
 - 2. Neat and uncluttered wire termination.
- L. Attach cables to permanent structure with suitable attachments at intervals not to exceed 6 feet.
- M. Support cabling and corrugated raceway a minimum of 6 inches above ceiling system.
- N. Install adequate support structures for 10-foot cable service loops in the MDF and in each IDF.

3.5 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-C.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.6 LABELING

- A. Labeling shall conform to ANSI/TIA/EIA-606 standards. In addition, provide the following:
 - 1. Label each outlet with permanent self-adhesive label with minimum 3/16-inch-high characters.
 - 2. Label each cable with permanent self-adhesive label with minimum, 1/8-inch-high characters, in the following locations:
 - a. Inside receptacle box at the work area.
 - b. Behind the communication closet patch panel or punch block.
 - 3. Use labels on face of data patch panels. Provide facility assignment records in a protective cover at each data closet location that is specific to the facilities terminated therein.
 - 4. Use color-coded labels for each termination field that conforms to ANSI/TIA/EIA-606 standard color codes for termination blocks.
 - 5. Labels shall be machine-printed. Hand-lettered labels shall not be acceptable.
 - 6. Label cables, outlets, and patch panels with prefixes (F=Fulton Building, followed by D=Data) and room number in which outlet is located, followed by a single letter suffix to indicate particular outlet within room; e.g., FD107A, FD107B. Indicate riser cables by an R then pair or cable number.
 - 7. Mark up floor plans showing outlet locations, type, and cable marking of cables. Turn these Contract Drawings over to the Owner 2 weeks prior to move in to allow the Owner's personnel to connect and test Owner-provided equipment in a timely fashion.

3.7 FIELD QUALITY CONTROL

- A. Project Superintendent shall be present during the course of the installation to provide coordination of work of these Specifications and of other trades and to provide technical information when requested by other trades.
- B. Testing:
 - 1. Completely test the existing data network prior to starting the work, and provide test report. At completion of data network revisions/additions in accordance with the Contract Documents, fully test the entire data network and provide test report. Provide 2 complete data network test reports.
 - 2. Provide test documentation certifying channel performance as stated in this Section. Provide hard copy of test records.
 - 3. Present documentation in form previously stated in this Section.
 - 4. Category 6 Cable Testing:
 - a. All Category 6 cables shall be tested in conformance with EIA/TIA 568A.
 - 1) All pairs in all cables shall be tested.
 - 2) A printed report documenting the following testing categories shall be provided:
 - a) Individual pair cable length.
 - b) Individual pair near-end crosstalk (NEXT).
 - c) Individual pair attenuation.
 - d) Individual pair attenuating to crosstalk ratio (ACR).
 - e) Wire map indicating:
 - (1) Proper pin termination at each end.
 - (2) Continuity to the remote end.
 - (3) Shorts between any two or more conductors.
 - (4) Crossed pairs.
 - (5) Reversed pairs.
 - (6) Split pairs.
 - (7) Any other mis-wires.

- 3) Correct wiring errors as required and/or cables that fail the testing requirements and confirm correct wire Amp indication.
- 4) Provide copies of the printed report as follows:
 - a) One copy shall be sent to the Engineer.
 - b) One copy shall be included with each of the Owner's operating and maintenance manuals.
 - c) Provide a compact disk with the full test report in PDF format.
- b. System labeling: Brother "P-Touch" or Engineer-approved labeling system will be used to label all faceplates, patch panels, and cabinets.

3.8 TRAINING

- A. Prior to acceptance by the Owner, provide one 4-hour training session for the Owner and staff. Training session shall cover the following items:
 1. Review of all as-built documentation.
 2. Review of all copper and fiber test results.
 3. Review of all labeling.
 4. Maintenance procedures.
 5. Troubleshooting procedures.
 6. Problem reporting procedures.
 7. Warranty information.

END OF SECTION

SECTION 28 31 20

FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Division 26 Section "General Requirements for Electrical" applies to the work of this Section.

1.2 SUMMARY

- A. Section Includes:
 1. Fire-alarm control unit with voice-alarm emergency communications systems.
 2. Manual fire-alarm boxes.
 3. System smoke detectors.
 4. Heat detectors.
 5. Carbon monoxide detectors.
 6. Notification appliances.
 7. Magnetic door holders.
 8. Remote annunciators.
 9. Addressable interface device.
 10. Elevator shutdown system.
 11. Digital alarm communicator transmitter.
 12. Fan shutdown.
 13. Battery backup.
 14. Additional devices, equipment, features, and circuiting associated with the fire-alarm-system requirements.
- B. Provide a complete fire-alarm system at the Main School Building.
- C. Unless otherwise indicated, disconnect and remove the existing fire-alarm system including associated devices, notification appliances, and associated circuiting and raceways complete.
 1. Maintain existing magnetic hold opens as called for on the document, remove and replace existing wiring to all door holders indicated to remain. Provide contacts/modules replacement door hold it wiring to allow access system to de-energize door hold opens upon activation of lockdown.
 2. Remove and replace existing door hold opens in associated wiring and raceways as called for in the documents.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.

1.4 SYSTEM DESCRIPTION

- A. The Main Building is presently served by a fire-alarm system that includes a control panel serving supervised, zoned devices. Existing system is manufactured by Notifier.
- B. Maintain present fire alarm in such a manner that the School is always protected by respective system and/or replacement system.

- C. Provide a complete, new, non-coded, fully addressable systems, with automatic sensitivity control of certain smoke detectors and multiplexed signal transmission, dedicated to fire-alarm service only.
- D. Provide temporary circuiting, connections, modules, and devices between each existing Siemens fire-alarm system and the new fire-alarm system to allow interfacing and communications between the two systems, to offer complete coverage of the School during the complete construction schedule. Provide additional components, equipment, hardware, and circuiting as required to interface the two systems.
- E. Provide modules, components, circuiting, and connections as required to interface and operate the existing fan shutdown system with the replacement fire-alarm system.
- F. Upon completion of testing the new fire-alarm system, disconnect and remove the existing main fire-alarm panel, additional panels and junction boxes, and all associated devices, equipment, circuiting, and raceways throughout the School.

1.5 PERFORMANCE REQUIREMENTS

- A. 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 SUBMITTALS

- A. General Submittal Requirements:
 - 1. Shop Drawings shall be prepared by persons trained and certified by manufacturer in fire-alarm-system design.
- B. Product Data: For each type of product indicated.
 - 1. Include construction details, material descriptions, dimensions, profiles, and finishes.
 - 2. Include rated capacities, operating characteristics, and electrical characteristics.
- C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and corrections/attachments to other work.
 - 1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
 - 2. Include voltage drop calculations for notification appliance circuits.
 - 3. Include battery-size calculations.
 - 4. Include performance parameters and installation details for each detector.
 - 5. Include floor plans to indicate final outlet locations showing address of each addressable device.
 - 6. Include complete system wiring diagrams and system riser.
 - 7. Indicated field wiring for fan and HVAC-unit shutdown.
 - 8. Include input/output matrix.
 - 9. Include statement from manufacturer that all equipment and components have been tested as a system and meet all the requirements in this Specification and in NFPA 72.
 - 10. Include voice/alarm signaling, service equipment rack or console layout grounding schematic, amplifier power calculations and single-line connection diagrams.
- D. Qualification Data: For qualified Installer.

- E. Field quality-control reports.
- F. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01, 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. Record copy of site-specific software.
 - 4. 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.
 - 5. Manufacturer's required maintenance related to system warranty requirements.
 - 6. Abbreviated operating instructions for mounting at fire-alarm control unit.
 - 7. Copy of NFPA 25.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- 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. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.
- D. System and equipment must meet the regulatory requirements and reference standards in Division 26 Section "General Requirements for Electrical."

1.8 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 Pull Stations: 10.
 - 2. Smoke Detectors with Addressable Bases: 10.
 - 3. Thermal Detectors with Addressable Bases: 10.
 - 4. Duct Smoke Detectors: 8.
 - 5. Audible and Visual Notification Appliances: 10.
 - 6. Visual-Only Appliance: 10.
 - 7. Addressable Modules: 10.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.

2. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Provide NOTIFIER (a Honeywell Company) #NSF2 series or approved equal by one of the following:
 1. Edwards System Technologies #EST3 series.
 2. Siemens.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices:
 1. Manual stations.
 2. Heat detectors.
 3. Smoke detectors.
 4. Duct smoke detectors.
 5. Verified automatic alarm operation of smoke detectors.
 6. Fire-extinguishing system operation.
 7. Ansul system at kitchen hood.
 8. Automatic sprinkler waterflow.
- B. Fire-alarm signal shall initiate the following actions:
 1. Continuously operate alarm notification appliances, including voice-evacuation notices.
 2. Identify alarm and specific initiating device at fire-alarm control unit and remote annunciators.
 3. Release fire and smoke doors held open by magnetic door holders.
 4. Close smoke dampers in air ducts of designated air distribution duct systems.
 5. Activate fan shutdown systems; both the new and the existing fan shutdown systems.
 6. Activate the digital communicator and transmit an alarm signal to the remote alarm-receiving station.
 7. Activate voice/alarm communication system.
 8. Activate signal to building energy management system.
 9. Activate emergency shutoffs for gas and fuel supplies.
 10. Record events in the system memory.
 11. Display activated device on control-panel character display and each remote-annunciator character display.
 12. Actuation of in-duct smoke detector shall shut down fans.
 13. Recall elevators to primary and alternate floors.
 14. Close smoke dampers in air ducts of designated duct systems.
- C. The fire-alarm system shall also provide monitoring of smoke hatches.
- D. System trouble signal initiation shall be by one or more of the following devices and actions:
 1. Open circuits, shorts, and grounds in designated circuits.
 2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
 3. Loss of primary power at fire-alarm control unit.
 4. Ground or a single break in fire-alarm control unit internal circuits.
 5. Abnormal ac voltage at fire-alarm control unit.
 6. Break in standby battery circuitry.
 7. Failure of battery charging.

8. Abnormal position of any switch at fire-alarm control unit or annunciator.
 9. Activation/initiation of carbon monoxide detectors.
 10. Voice-signal amplifier failure.
- E. In addition to transmission of "Trouble" signal to fire-alarm control panel and central receiving station, activation of a carbon monoxide sensor shall annunciate as "Toxic Gas Alert" at central receiving station.
- F. Provide system wiring utilizing galvanized interlocking steel fire-alarm control cable with red stripe.

2.3 FIRE-ALARM CONTROL UNIT

- A. General Requirements for Fire-Alarm Control Unit:
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 and printer.
 2. Addressable initiation devices that communicate device identity and status.
 3. Addressable control circuits for operation of mechanical equipment.
- B. General Requirements for Fire-Alarm Control Unit:
1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
 - a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, 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 and printer.
 - c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
 - d. The FACP shall be listed for connection to a central-station signaling system service.
 - e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.
 2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
 3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.
- C. 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, 80 characters, minimum.
 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.
- D. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
1. Pathway Class Designations: NFPA 72, Class B.
 2. Pathway Survivability: Level 0.

3. Install no more than 256 addressable devices on each signaling-line circuit.
 4. Serial Interfaces:
 - a. One dedicated RS 485 port for remote station operation using point ID DACT.
 - b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
 - c. One USB port for PC configuration.
 - d. One RS 232 port for VESDA HLI connection.
 - e. One RS 232 port for voice evacuation interface.
- E. Smoke-Alarm Verification:
1. This capability shall be disabled and not used on the fire-alarm system.
- F. Notification-Appliance Circuit:
1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
 2. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.
- G. Elevator Recall:
1. Elevator recall shall be initiated only by one of the following alarm-initiating devices:
 - a. Elevator lobby detectors except the lobby detector on the designated floor.
 - b. Smoke detector in elevator machine room.
 - c. Smoke detectors in elevator hoistway.
 2. Elevator controller shall be programmed to move the cars to the alternate recall floor if lobby detectors located on the designated recall floors are activated.
- H. 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.
- I. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
- J. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided as a special module that is part of fire-alarm control unit.
1. Indicate 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.
 - a. Allow the application of, and evacuation signal to, indicated number of zones and, at the 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.
 3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.

- K. 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, and 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.
- L. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
1. Batteries: Sealed lead calcium.
- M. 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.
- N. Digital Voice Command Center:
1. The Digital Voice Command Center located with the FACP, shall contain all equipment required for all audio control, emergency telephone system control, signaling and supervisory functions. This shall include speaker zone indication and control, telephone circuit indication and control, digital voice units, microphone and main telephone handset. The DVC shall support up to 8 channels of voice when configured with Digital Audio Amplifiers and 4 channels of voice when employing the optional analog output card. Each DVC shall support up to 32 digital audio amplifiers.
 2. Function: The Voice Command Center equipment shall perform the following functions:
 - a. Operate as a supervised multi-channel emergency voice communication system.
 - b. Operate as a two-way emergency telephone system control center. Audibly and visually annunciate the active or trouble condition of every speaker circuit and emergency telephone circuit.
 - c. Audibly and visually annunciate any trouble condition for digital tone and voice units required for normal operation of the system.
 - d. Provide all-call Emergency Paging activities through activation of a single control switch.
 - e. As required, provide vectored paging control to specific audio zones via dedicated control switches.
 - f. Provide a factory recorded "library" of voice messages and tones in standard WAV. File format, which may be edited and saved on a PC running a current Windows® operating system.
 - g. Provide a software utility capable of off-line programming for the DVC operation and the audio message files. This utility shall support the creation of new programs as well as editing and saving existing program files. Uploading or downloading the DVC shall not inhibit the emergency operation of other nodes on the fire alarm network.
 - h. Support an optional mode of operation with four analog audio outputs capable of being used with UL 864 fire-listed analog audio amplifiers and SLC-controlled switching.
 - i. The Digital Voice Command shall be modular in construction and shall be capable of being field programmable without requiring the return of any components to the manufacturer and without requiring use of any external computers or other programming equipment.
 - j. The Digital Voice Command and associated equipment shall be protected against unusually high voltage surges or line transients.
 3. The emergency voice alarm communication system shall incorporate a Two-way emergency telephone communication system.

- a. Two-way emergency telephone communication circuits shall be supervised for open and short circuit conditions.
 - b. Two-way emergency telephone (Fire Fighter Telephone) communication shall be supported between the Digital Voice Audio Command Center and up to seven remote Fire Fighter's Telephone locations simultaneously on a telephone riser.
 - c. Means shall be provided to connect FFT voice communications to the speaker circuits in order to allow voice paging over the speaker circuit from a telephone handset.
- O. Audio Amplifiers:
- 1. The Audio Amplifiers will provide Audio Power (at 25-Volt RMS or 70 RMS) for distribution to speaker circuits.
 - 2. Multiple audio amplifiers may be mounted in a single enclosure, either to supply incremental audio power, or to function as an automatically switched backup amplifier(s).
 - 3. The audio amplifier shall include an integral power supply, and shall provide built-in LED indicators for the following conditions:
 - a. Earth Fault on DAP A (Digital Audio Port A)
 - b. Earth Fault on DAP B (Digital Audio Port B)
 - c. Audio Amplifier Failure Detected Trouble
 - d. Active Alarm Bus input
 - e. Audio Detected on Aux Input A
 - f. Audio Detected on Aux Input B
 - g. Audio Detected on Firefighter's Telephone Riser
 - h. Receiving Audio from digital audio riser
 - i. Short circuit on speaker circuit 1
 - j. Short circuit on speaker circuit 2
 - k. Short circuit on speaker circuit 3
 - l. Short circuit on speaker circuit 4
 - m. Data Transmitted on DAP A
 - n. Data Received on DAP A
 - o. Data Transmitted on DAP B
 - p. Data Received on DAP B
 - q. Board failure
 - r. Active fiber optic media connection on port A (fiber optic media applications)
 - s. Active fiber optic media connection on port B (fiber optic media applications)
 - t. Power supply Earth Fault
 - u. Power supply 5-V present
 - v. Power supply conditions - Brownout, High Battery, Low Battery, Charger Trouble
 - 4. The audio amplifier shall provide the following built-in controls:
 - a. Amplifier Address Selection Switches
 - b. Signal Silence of communication loss annunciation Reset.
 - c. Level adjustment for background music
 - d. Enable/Disable for Earth Fault detection on DAP A
 - e. Enable/Disable for Earth Fault detection on DAP B
 - f. Switch for 2-wire/4-wire FFT riser
 - 5. Adjustment of the correct audio level for the amplifier shall not require any special tools or test equipment.
 - 6. Includes audio input and amplified output supervision, back up input, and automatic switch over function, (if primary amplifier should fail).
 - 7. System shall be capable of backing up digital amplifiers.
 - 8. One-to-one backup shall be provided by either a plug-in amplifier card or a designated backup amplifier of identical model as the primary amplifier.
 - 9. One designated backup amplifier shall be capable of backing up multiple primary

- amplifiers mounted in the same or adjacent cabinets.
10. Multi-channel operation from a single amplifier shall be supported by the addition of an optional plug-in amplifier card.

P. Audio Message Generator (Prerecorded Voice)/Speaker Control:

1. Each initiating zone or intelligent device shall interface with an emergency voice communication system capable of transmitting a prerecorded voice message to all speakers in the building.
2. Actuation of any alarm initiating device shall cause a prerecorded message to sound over the speakers. The message shall be repeated four (4) times. Pre- and post-message tones shall be supported.
3. A built-in microphone shall be provided to allow paging through speaker circuits.
4. System paging from emergency telephone circuits shall be supported.
5. The audio message generator shall have the following indicators and controls to allow for proper operator understanding and control:
 - a. Lamp Test
 - b. Trouble
 - c. Off-Line Trouble
 - d. Microphone Trouble
 - e. Phone Trouble
 - f. Busy/Wait
 - g. Page Inhibited
 - h. Pre/Post Announcement Tone

Q. Controls with associated LED Indicators:

1. Speaker Switches/Indicators:
 - a. The speaker circuit control switches/indicators shall include visual indication of active and trouble status for each speaker circuit in the system.
 - b. The speaker circuit control panel shall include switches to manually activate or deactivate each speaker circuit in the system.
2. Emergency Two-Way Telephone Control Switches/Indicators:
 - a. The emergency telephone circuit control panel shall include visual indication of active and trouble status for each telephone circuit in the system.
 - b. The telephone circuit control panel shall include switches to manually activate or deactivate each telephone circuit in the system.

R. Specific System Operations:

1. Smoke Detector Sensitivity Adjust: A means shall be provided for adjusting the sensitivity of any or all addressable intelligent detectors in the system from the system keypad. Sensitivity range shall be within the allowed UL window and have a minimum of 9 levels.
2. Alarm Verification: Each of the intelligent addressable smoke detectors in the system may be independently selected and enabled to be an alarm verified detector. The alarm verification delay shall be programmable from 0 to 60 seconds and each detector shall be able to be selected for verification. The FACP shall keep a count of the number of times that each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.
3. Point Disable: Any addressable device in the system may be enabled or disabled through the system keypad.
4. Point Read: The system shall be able to display or print the following point status diagnostic functions:
 - a. Device status
 - b. Device type

- c. Custom device label
 - d. View analog detector values.
 - e. Device zone assignments
5. System History Recording and Reporting: The fire alarm control panel shall contain a history buffer that will be capable of storing up to 800 events. Up to 200 events shall be dedicated to alarm and the remaining events are general purpose. Systems that do not have dedicated alarm storage, where events are overridden by non-alarm type events, are not suitable substitutes. Each of these activations will be stored and time and date stamped with the actual time of the activation. The contents of the history buffer may be manually reviewed, one event at a time, or printed in its entirety. The history buffer shall use non-volatile memory. Systems that use volatile memory for history storage are not acceptable substitutes.
 6. Automatic Detector Maintenance Alert: The fire alarm control panel shall automatically interrogate each intelligent detector and shall analyze the detector responses over a period of time. If any intelligent detector in the system responds with a reading that is above or below normal limits, then the system will enter the trouble mode, and the particular detector will be annunciated on the system display and printed on the optional printer. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.
 7. Pre-Alarm Function: The system shall provide two levels of pre-alarm warning to give advance notice of a possible fire situation. Both pre-alarm levels shall be fully field adjustable. The first level shall give an audible indication at the panel. The second level shall give an audible indication and may also activate control relays. The system shall also have the ability to activate local detector sounder bases at the pre-alarm level, to assist in avoiding nuisance alarms.
 8. Software Zones: The FACP shall support 142 independent programmable software zones.
 9. The fire alarm control panel shall include a walk test feature. It shall include the ability to test initiating device circuits and notification appliance circuits from the field without returning to the panel to reset the system. Operation shall be as follows:
 - a. Alarming an initiating device shall activate programmed outputs, which are selected to participate in walk test, for 3 seconds.
 - b. Introducing a trouble into the initiating device shall activate the programmed outputs for 8 seconds.
 - c. All devices tested in walk test shall be recorded in the history buffer.
 10. Multiple Agent Releasing Zones: The system shall support up to 10 releasing zones to protect against 10 independent hazards. Releasing zones shall provide up to three cross-zone and four abort options to satisfy any local jurisdiction requirements.
 11. Mass Notification Override: The system shall be UL 2572 listed for Mass Notification and shall be capable, based on the Risk Analysis, of being programmed so that Mass Notification/Emergency Communications events take precedence over fire alarm events.
- S. Portable Emergency Telephone Handset Jack:
1. Portable emergency telephone handset jacks shall be flush mounted on stainless steel plates as indicated on the plans. Jacks shall be approved for emergency telephone system application.
 2. Insertion of a portable handset plug into a jack shall send a signal to the fire command center, which shall audibly and visually indicate the on-line condition, and shall sound a "ring" indication in the handset.
 3. The two-way emergency telephone system shall support a minimum of seven handsets online without degradation of the signal.

- T. Fixed Emergency Telephone Handset:
1. The telephone cabinet shall be painted red and clearly labeled as "Emergency Telephone." The cabinets shall be located where shown on drawings.
 2. The handset cradle shall have a switch connection so that lifting the handset off of the cradle shall send a signal to the fire command center, which shall audibly and visually indicate its on-line (off-hook) condition.
 3. On activating the remote phone, the phone earpiece shall sound a telephone ring signal until the master handset is lifted.
 4. The two-way emergency telephone system shall support a minimum of seven handsets online without degradation of the signal.
- U. All interfaces and associated equipment are to be protected so that they will not be affected by voltage surges or line transients consistent with UL standard 864.
- V. Communicators:
1. The UDACT shall be compact in size, mounting in a standard module position of the fire alarm control cabinet. Optionally, the UDACT shall have the ability for remote mounting, up to 6,000 feet from the fire alarm control panel. The wire connections between the UDACT and the control panel shall be supervised with one pair for power and one pair for multiplexed communication of overall system status. Systems that utilize relay contact closures are not acceptable.
 2. The UDACT shall include connections for dual telephone lines (with voltage detect), per UL/NFPA/FCC requirements. It shall include the ability for split reporting of panel events up to two different telephone numbers.
 3. The UDACT shall be capable of transmitting events in 4+2, SIA, and Contact ID.
 4. Communication shall include vital system status such as:
 - a. Independent Zone (Alarm, trouble, non-alarm, supervisory)
 - b. Independent Addressable Device Status
 - c. AC (Mains) Power Loss
 - d. Low Battery and Earth Fault
 - e. System Off Normal
 - f. 12- and 24-Hour Test Signal
 - g. Abnormal Test Signal (per UL requirements)
 - h. EIA-485 Communications Failure
 - i. Phone Line Failure
 5. The UDACT shall support independent zone/point reporting when used in the Contact ID format. In this format the UDACT shall support transmission of up to 3,064 points. This enables the central station to have exact details concerning the origin of the fire or response emergency.
 6. The UDACT shall be capable of being programmed with the same programming utility as the host FACP, and saved, edited and uploaded and downloaded using the utility. UDACT shall be capable of being programmed online or offline. The programming utility shall also support upgrading UDACT operating firmware.
 7. The UDACT shall be capable of generating Central Station reports providing detailed programming information for each point along with the central station point address.
 8. An IP or IP/GSM Communicator option shall be available to interface to the UDACT and be capable of transmitting signals over the internet/intranet or Cellular (GSM) network to a compatible receiver.

2.4 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. 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. Provide manufacturer's surface back box at locations where surface-mounted units are required.

1. Double-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key- or wrench-operated switch.
3. Indoor Protective Shield: Factory-fabricated clear plastic enclosure 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.

2.5 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:
 1. Comply with UL 268; operating at 24-V dc, nominal.
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
 3. 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.
 4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 5. Integral Visual-Indicating Light: LED type indicating detector has operated.

- B. Photoelectric Smoke Detectors:
 1. 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.
 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. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
 1. 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.
 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.).
 3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
 4. Each sensor shall have multiple levels of detection sensitivity.
 5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
 6. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan control circuit.

2.6 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.

- B. Heat Detector, Combination Type: 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.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 2. 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 190 deg F.
1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
 3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.7 CARBON MONOXIDE DETECTORS

- A. General Requirements for Carbon Monoxide Detectors: Meets the requirements of NFPA 720 and UL 2075 and meets CO sensitivity limits of UL 2034 standard.
- B. Mounting: Adapter plate for outlet-box mounting.
- C. Operates from a reliable electro-chemical CO cell, transmitting CO concentration on an independent signal, separate from the fire-detection signals to the fire-alarm control panel. Provide detector with alarm contacts and trouble contacts.
- D. Provides a supervision of the carbon monoxide level and is customizable for special applications. Configurable range is 30–600 ppm.
- E. Locate, mount, and wire according to manufacturer's written instructions.
- F. Addressable Device: Provide with an intelligent audible base at each detector to annunciate upon initiation of signal by associated detector. In addition, carbon monoxide detectors located adjacent to the Boiler Room shall also annunciate sounder base if Boiler Room detector is initiated. Provide sounder base with six different field-selectable tone patterns. Sounder base to meet NFPA 72 and NFPA 720,

2.8 SMOKE DAMPERS

- A. General: Existing and new smoke dampers are indicated on Drawings and shall be connected and wired by Division 28 Contractor.
- B. Coordinate and verify exact locations of new and existing smoke dampers with Division 23 Contractor. Disconnect and remove fire-alarm circuiting, raceway, and connections at existing smoke dampers that are no longer required.
- C. Provide addressable module at each smoke damper and connect integral smoke detector to fire-alarm system via addressable module. Connect to initiation circuit in accordance with manufacturer's recommendations.
- D. Provide 120-V control modules and power wiring circuit to each smoke damper via fire-alarm panel for damper operation. Verify exact voltage requirements at existing smoke dampers prior to removals and rough-in.

2.9 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, 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.

2. Provide wire guards at all gymnasium and locker room locations and at locations marked "WG" on the Contract Documents.
3. Provide weatherproof units at all exterior locations and locations marked "WP." Provide stainless steel, heavy gauge wire guards at all exterior locations.
4. Mounting: Flush-on-flush back box.
5. Provide system-supplied back box when device must be surface mounted.

B. Speakers:

1. The speaker shall be listed to UL 1480 for Fire Protective Signaling Systems. It shall be a dual-voltage transformer speaker capable of operation at 25.0 or 70.7 nominal Vrms. The speaker shall have a frequency range of 400 to 4,000 Hz and shall have an operating temperature between 32 deg F and 120 deg F. Mount to a 4- x 4- x 2-1/8-inch back box.
2. Provide a universal mounting plate for mounting ceiling and wall speaker products. The notification appliance circuit and amplifier wiring shall terminate at the universal mounting plate.
3. Speakers shall be plug-in and shall have the ability to check wiring continuity via a shorting spring on the universal mounting plate. The shorting spring shall also provide tamper resistance via an open circuit if the device is removed. Speaker design shall isolate speaker components to reduce ground fault incidents.
4. The speaker shall have power taps (from 1/4 watt to 2 watts) and voltage that are selected by rotary switches. All models shall have a maximum sound output of 86 dB at 10 feet and shall incorporate an open back construction.
5. All notification appliances shall be backward compatible.

C. Combination Speaker Strobes:

1. Combination speaker strobe shall be listed to UL 1971 and UL 1480 and be approved for fire protective signaling systems. It shall be a dual-voltage transformer speaker strobe capable of operation at 25.0 or 70.7 nominal Vrms. The speaker shall have a frequency range of 400 to 4,000 Hz and shall have an operating temperature between 32 deg F and 120 deg F. Mount to a 4- x 4- x 2-1/8-inch back box.
2. Provide a universal mounting plate shall be used for mounting ceiling and wall speaker strobe products. The notification appliance circuit and amplifier wiring shall terminate at the universal mounting plate.
3. Speaker strobes shall be plug-in and shall have the ability to check wiring continuity via a shorting spring on the universal mounting plate. The shorting spring shall also provide tamper resistance via an open circuit if the device is removed. Speaker strobe design shall isolate speaker components to reduce ground fault incidents.
4. The speaker strobe shall have power taps (from 1/4 watt to 2 watts) and voltage that are selected by rotary switches. All models shall have a maximum sound output of 86 dB at 10 feet and shall incorporate an open back construction. The strobe shall consist of a xenon flash tube with associated lens/reflector system and operate on either 12 V or 24 V. The strobe shall also feature selectable candela output, providing options for 15 or 15/75 candela when operating on 12 V and 15, 15/75, 30, 75, 110, or 115 when operating on 24 V. The strobe shall comply with NFPA 72 and the Americans with Disabilities Act requirement for visible signaling appliances, flashing at 1 Hz over the strobe's entire operating voltage range.
5. All notification appliances shall be backward compatible.

D. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.

1. Rated Light Output:

- a. 15/30/75/110 cd, selectable in the field. Set visual device to 75 cd unless noted otherwise on Documents or required to meet NFPA requirements.
- 2. Mounting: Wall mounted unless otherwise indicated.
- 3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
- 4. Flashing shall be in a temporal pattern, synchronized with other units.
- 5. Strobe Leads: Factory connected to screw terminals.
- 6. Mounting Faceplate: Factory-finished, red.

2.10 MAGNETIC DOOR HOLDERS

- A. Description: Provide units equipped for wall mounting as indicated and are complete with matching doorplate.
 - 1. Electromagnet: Requires no more than 3 W to develop 25-lbf holding force.
 - 2. Wall-Mounted Units: Flush-mounted unless otherwise indicated.
 - 3. Rating: Multi-volt field selectable 24V/120V.
 - 4. Coordinate location with Division 08.
 - 5. Include all necessary mounting and adaptive hardware including armature extensions as required to achieve degree of opening required.
- B. Material and Finish: Match door hardware.
- C. Reuse and rewire existing magnetic door holders as called for in the documents. Match the voltage of the existing door holders that remain.

2.11 REMOTE ANNUNCIATORS WITH MICROPHONE

- A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing. Provide each remote annunciator with microphone kit/assembly adjacent or integral to housing.
 - 1. Mounting: Provide flush-mounted cabinet at new construction and surface-mounted cabinet at existing construction.
- B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.
- C. Provide circuiting and connectivity from microphone assembly back to main panel to allow broadcast announcements from microphone to fire-alarm speakers. Provide component modules and programming to coordinate fire-alarm signaling and microphone use.
- D. Provide within steel enclosure/housing.
- E. Provide 4 remote annunciators at the School—one at each of the following spaces/areas:
 - 1. Middle School Entrance Vestibule 1223.
 - 2. High School Entrance Vestibule 12V1.
 - 3. High School Office 1301.
 - 4. Elementary School Entrance 11V4.

2.12 ADDRESSABLE INTERFACE DEVICE

- A. General:
 - 1. Include address-setting means on the module.
 - 2. Store an internal identifying code for control panel use to identify the module

- type.
 - 3. Listed for controlling HVAC fan motor controllers.
- B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- C. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall.
 - 1. Allow the control panel to switch the relay contacts on command.
 - 2. Have a minimum of two normally open and two normally closed contacts available for field wiring.
- D. Control Module:
 - 1. Operate notification devices.
 - 2. Operate solenoids for use in sprinkler service.

2.13 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.
- B. Functional Performance: 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 remote central station. 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. 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.
- 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. Low battery.
- E. Secondary Power: Integral rechargeable battery and automatic charger.
- F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.
- G. Special features shall include:
 - 1. Voltage surge protection.
 - 2. Two-number dialing per channel.
 - 3. Rotary to touch-tone dialing.
 - 4. Lightning protection.

2.14 DEVICE GUARDS

- A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
 - 1. Factory fabricated and furnished by manufacturer of device.
 - 2. Finish: Paint of color to match the protected device.

2.15 WIRE

- A. General: Provide galvanized interlocking strip steel with red stripe armor with solid conductors within.
 - 1. Assembly: Polyester assembly tape; twisted shield; laminated aluminum/Mylar shield with tinned copper drain wire.
 - 2. Fully plenum-rated, FPLP.
 - 3. Manufacturer: AFC Cable Systems fire alarm/control cable.
- B. Initiating Line Circuits:
 - 1. Number of conductors as recommended by fire-alarm-system manufacturer and in accordance with NEC Article 760. Conductor size shall not be less than No. 14 AWG.
 - 2. Visual devices shall be circuited separate from audible devices.
- C. Signal Line Circuits:
 - 1. Number of conductors and conductor size as recommended by fire-alarm-system manufacturer and in accordance with NEC Article 760.
 - 2. Solid-copper conductors, twisted, shielded, jacketed, as recommended by system manufacturer.
- D. Door holders (24 V): No. 14 AWG, copper, 600 volts, THHN insulation. Provide insulated "green" ground conductor with all door-holder circuitry.
- E. Miscellaneous control circuits: No. 12 AWG, copper, 600 volts, THHN insulation.

2.16 CONNECTIONS

- A. All terminals and splices of cable shall be made with self insulated compression type fittings.
- B. Basis-of-Design Product: Thomas & Betts "sta-Kon"
 - 1. Termination: Forked tongue "RA" series.
 - 2. Splices: "RB," "RC," and "RP" series.

2.17 FAN SHUTDOWN COMPONENTS AND CIRCUITING

- A. Complete relay control package of modular construction mounted in fire-alarm control panel.
- B. The fire-alarm system shall supervise the coil of each relay. Any abnormal conditions shall indicate an individual trouble alarm for each relay.
- C. The contacts of each relay shall be supervised by the interface to the energy management system.
- D. Provide drill bypass feature; locate switch on fire-alarm control panel and label "Drill-Fan Shutdown Bypass." Audible buzzer shall sound continuously while in bypass mode.

- E. Provide modules, components, circuiting, and connections to activate existing fan shutdown via replacement fire-alarm system.
- F. Provide fan reset feature; locate switch on fire-alarm control panel and label "Fan Reset."

2.18 STANDBY BATTERY AND CHARGER

- A. Standby battery shall be provided through 24-V dc battery and automatic charger.
- B. Maintenance-free lead-calcium batteries; ampere-hour capacity which will allow fire-alarm-system functions to operate as called for.
- C. Standby batteries shall be sized to maintain non-alarm supervisory power condition for 60 hours followed by 15 consecutive minutes in full load alarm on battery power only.
- D. Cell reversal protection for batteries. Life expectancy shall be 10 years maximum. Battery connections shall be fused.
- E. Batteries shall be supervised. Battery charge, when low, shall initiate an LED flashing signal and trouble circuit shall sound. The LED signal shall remain until the condition is corrected; audible signal shall annunciate until acknowledged.
- F. Battery removal, blown fuses, or faulty wiring shall also cause a low battery condition.
- G. Charger shall be self-regulating, solid-state type, automatic with capability to fully charge the completely drained battery within 5 hours.
- H. Locate charger and associated batteries within the fire-alarm control panel or in NEMA 1 enclosure adjacent to the panel.
- I. Manufacturer: Same as control panel.

2.19 SMOKE DAMPERS

- A. Provide control modules and 120-volt circuiting from main control panel to each smoke damper.
- B. Provide addressable modules at each smoke damper, and circuit integral smoke detector (at smoke damper) to fire-alarm control panel via addressable module.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.
- B. Install wall-mounted equipment, with tops of cabinets not more than 72 inches above the finished floor.
- C. Manual Stations: 48 inches to center, above finished floor, on flush box.
- D. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.
- E. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.

- F. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
- G. Audible/Visual Alarm-Indicating Devices: Install not less than 80 inches above finished floor unless otherwise noted. Install horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
- H. Visible Alarm-Indicating Devices: Same height as audible/visual device.
- I. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- J. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches above the finished floor.
- K. Annunciator: Install with top of panel not more than 54 inches above the finished floor.

3.2 CONNECTIONS

- A. It is the intent that the system be wired Class B, all wiring in armor/steel-sheathed conductors conduit/raceway in accordance with National Electric Code, Article 760. Metallic conduit systems shall be provided in all masonry walls, mechanical rooms, equipment/storage rooms, exposed ceiling structures. Conduit shall be concealed in all finished areas.
 - 1. Cables shall terminate in electrical boxes.
 - 2. Provide slack cable at each device in accordance with equipment contractor's instructions.
 - 3. Label all cables, both ends as directed by system equipment contractor's instructions.
- B. Make addressable connections with a supervised interface device to the following devices and systems. 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. Smoke dampers in air ducts of designated air-conditioning duct systems.
 - 2. Alarm-initiating connection to activate emergency lighting control.
 - 3. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
 - 4. Existing fan shutdown system.
 - 5. All sprinkler system flow and tamper switches.
- C. Provide three 20-Amp, 120-V circuits to the main fire-alarm control panel.
- D. Provide one 20-Amp, 120-V circuit to each of the following:
 - 1. Annunciator.
 - 2. Transponder.
 - 3. Smoke-hatch control.
- E. Provide wiring to smoke relief hatches. Smoke relief hatches shall operate only when its associated detector is in alarm.
- F. Provide wiring to smoke duct detectors and the associated dampers for control and operation.
 - 1. Provide wiring to each smoke damper, which shall include two separate isolated circuits. Provide connection to integral smoke detector from fire-alarm initiation circuit. Provide separate power circuitry from fire-alarm control panel to each smoke damper for damper operation.

- G. Provide wiring required for fan shutdown, both existing fan shutdown systems and added fan shutdown.
- H. Provide wiring to energy management system. Provide required circuitry, connections, and terminations to provide communications and control between the main fire-alarm system and energy management system.
- I. Provide circuiting and connections to kitchen-hood Ansul system.
- J. Coordinate the digital communication with the facility representative and comply with the local fire department requirements and regulations.
- K. Provide all circuiting to magnetic door hold-open devices, match voltage of existing door holders that remain. Provide interface module at all door hold open circuits to allow interface to door access system for lockdown activation. Isolate the wiring to all new/replacement door holders from the circuiting to the existing door holders.
- L. Provide all circuiting to activate, monitor, and control elevator recall.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

3.4 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.5 FIELD QUALITY CONTROL

- A. 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. 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. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 - 3. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" 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.

- C. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- D. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.6 SYSTEM PROGRAMMING

- A. Allow for 3 programming modifications to be provided as part of the construction phasing plan and the final coordination of the system installation. Provide programming modifications as directed by the Architect.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.
- B. Provide a total of two 4-hour training sessions to Owner's personnel. Coordinate the training schedule with the Owner's Representative.

END OF SECTION

SECTION 28 31 20.50

FIRE-ALARM SYSTEM FOR EXISTING BUS GARAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Division 26 Section "General Requirements for Electrical" applies to the work of this Section.

1.2 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. Digital alarm communicator transmitter.
 10. Fan shutdown.
 11. Battery backup.
 12. Additional devices, equipment features, and circuiting associated with fire-alarm-system requirements.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.

1.4 SYSTEM DESCRIPTION

- A. Provide additions and revisions to the existing fire alarm system at the bus garage is called for in the contract documents.
- B. The existing fire alarm system/main panel is by Firelite Alarms/Honeywell "MS9200" series system. Provide all devices, components equipment, circuiting and connections to maintain and coordinate with the existing Firelite/Honeywell system.

1.5 PERFORMANCE REQUIREMENTS

- A. 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 SUBMITTALS

- A. General Submittal Requirements:
 1. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire-alarm system design.
- B. Product Data: For each type of product indicated.

- C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and corrections/attachments to other work.
 - 1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
 - 2. Include voltage drop calculations for notification appliance circuits.
 - 3. Include battery-size calculations.
 - 4. Include performance parameters and installation details for each detector.
 - 5. Include floor plans to indicate final outlet locations showing address of each addressable device.
- D. Qualification Data: For qualified Installer.
- E. Field quality-control reports.
- F. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1, 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. Record copy of site-specific software.
 - 4. 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.
 - 5. Manufacturer's required maintenance related to system warranty requirements.
 - 6. Abbreviated operating instructions for mounting at fire-alarm control unit.
 - 7. Copy of NFPA 25.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- 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. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL.
- D. System and equipment must meet the regulatory requirements and reference standards in Division 26 Section "General Requirements for Electrical."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Product: The existing fire alarm system is by Firelite/Honeywell. Subject to compliance with requirements, provide devices and equipment by Firelite/Honeywell.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices:
 - 1. Manual stations.

2. Heat detectors.
 3. Smoke detectors.
 4. Duct smoke detectors.
 5. Verified automatic alarm operation of smoke detectors.
 6. Fire-extinguishing system operation at the fueling island.
- B. Fire-alarm signal shall initiate the following actions:
1. Continuously operate alarm notification appliances.
 2. Identify alarm at fire-alarm control unit and remote annunciators.
 3. Release fire and smoke doors held open by magnetic door holders.
 4. Close smoke dampers in air ducts of designated air distribution duct systems.
 5. Activate fan shutdown system.
 6. Activate the digital communicator.
 7. Activate signal to building energy management system.
 8. Record events in the system memory.
 9. Display activated device on control panel character display and each remote annunciator character display.
- C. The fire alarm system shall also provide the following:
1. Monitoring of smoke hatches.
 2. Automatic control of ventilation fan.
- D. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
 2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
 3. Loss of primary power at fire-alarm control unit.
 4. Ground or a single break in fire-alarm control unit internal circuits.
 5. Abnormal ac voltage at fire-alarm control unit.
 6. Break in standby battery circuitry.
 7. Failure of battery charging.
 8. Abnormal position of any switch at fire-alarm control unit or annunciator.
- E. Provide system wiring within a complete raceway system.

2.3 FIRE-ALARM CONTROL UNIT

- A. Existing fire alarm control panel is Firelite/Honeywell "MS9200".
- B. Circuits:
1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class B.
 - a. Initiating Device Circuits: Style D.
 - b. Notification Appliance Circuits: Style Z.
 - c. Signaling Line Circuits: Style 6.
 - d. Install no more than 50 addressable devices on each signaling line circuit.
- C. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to fire-alarm system.

2.4 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. 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.

Provide manufacturer's surface back box at locations where surface-mounted units are required.

1. 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.
2. Station Reset: Key- or wrench-operated switch.
3. Indoor Protective Shield: Factory-fabricated clear plastic enclosure 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.

2.5 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:
1. Comply with UL 268; operating at 24-V dc, nominal.
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
 3. 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.
 4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 5. Integral Visual-Indicating Light: LED type indicating detector has operated.
- B. Photoelectric Smoke Detectors:
1. 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.
 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. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
1. 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.
 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.).
 3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
 4. Each sensor shall have multiple levels of detection sensitivity.
 5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.

2.6 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.
- B. Heat Detector, Combination Type: 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.
1. Mounting: Twist-lock base interchangeable with smoke-detector bases.

2. 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 190 deg F.
1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
 3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.7 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, 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.
 2. Provide wire guards at all gymnasium and locker room locations and at locations marked "WG" on the Contract Documents.
- B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol. Sound level shall be field-adjustable for 3 different output levels.
- C. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.
1. Rated Light Output:
 - a. 75 cd.
 - b. 15/30/75/110 cd, selectable in the field. Adjust and set cd levels to meet NFPA requirements for the area of location.
 2. Mounting: Wall mounted unless otherwise indicated.
 3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
 4. Flashing shall be in a temporal pattern, synchronized with other units.
 5. Strobe Leads: Factory connected to screw terminals.
 6. Mounting Faceplate: Factory finished, red.

2.8 ADDRESSABLE INTERFACE DEVICE

- A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.

2.9 DEVICE GUARDS

- A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
1. Factory fabricated and furnished by manufacturer of device.
 2. Finish: Paint of color to match the protected device.

2.10 WIRE

- A. Provide all wiring/circuiting within raceway system.
- B. Initiating Line Circuits:

1. Number of conductors as recommended by fire alarm system manufacturer and in accordance with NEC Article 760. Conductor size shall not be less than #14 AWG.
 2. Visual devices shall be circuited separate from audible devices.
- C. Signal Line Circuits:
1. Number of conductors and conductor size as recommended by fire alarm system manufacturer and in accordance with NEC Article 760.
 2. Solid-copper conductors, twisted, shielded, jacketed, as recommended by system manufacturer.
- D. Door holders (120 V): #14 AWG, copper, 600 volts, THHN insulation. Provide insulated "green" ground conductor with all door-holder circuitry.
- E. Miscellaneous control circuits: #12 AWG, copper, 600 volts, THHN insulation.

2.11 CONNECTIONS

- A. All terminals and splices of cable shall be made with self-insulated compression type fittings.
- B. Manufacturer: Thomas & Betts "sta-Kon"
1. Termination: Forked tongue "RA" series.
 2. Splices: "RB," "RC," and "RP" series.

2.12 FAN SHUTDOWN COMPONENTS AND CIRCUITING

- A. Complete relay control package of modular construction mounted in fire alarm control panel.
- B. The fire alarm system shall supervise the coil of each relay. Any abnormal conditions shall indicate an individual trouble alarm for each relay.
- C. The contacts of each relay shall be supervised by the interface to the energy management system.
- D. Provide drill bypass feature; locate switch on fire alarm control panel and label "Drill-Fan Shutdown Bypass." Audible buzzer shall sound continuously while in bypass mode.
- E. Provide fan reset feature; locate switch on fire alarm control panel and label "Fan Reset."

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.
- B. Install wall-mounted equipment, with tops of cabinets not more than 72 inches above the finished floor.
- C. Manual Stations: 48 inches to center, above finished floor, on flush box.
- D. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.
- E. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.

- F. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
- G. Audible/Visual Alarm-Indicating Devices: Install not less than 80 inches above finished floor unless otherwise noted. Install horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
- H. Visible Alarm-Indicating Devices: Same height as audible/visual device.
- I. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- J. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches above the finished floor.
- K. Annunciator: Install with top of panel not more than 54 inches above the finished floor.

3.2 CONNECTIONS

- A. It is the intent that the system be wired Class B, all wiring in conduit/raceway in accordance with National Electric Code, Article 760. Metallic conduit systems shall be provided in all masonry walls, mechanical rooms, equipment/storage rooms, exposed ceiling structures. Conduit shall be concealed in all finished areas.
 - 1. Cables shall terminate in electrical boxes.
 - 2. Provide slack cable at each device in accordance with equipment contractor's instructions.
 - 3. Label all cables, both ends as directed by system equipment contractor's instructions.
- B. Make addressable connections with a supervised interface device to the following devices and systems. 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. Smoke dampers in air ducts of designated air-conditioning duct systems.
- C. Provide wiring to smoke duct detectors and the associated dampers for control and operation.
- D. Provide wiring required for fan shutdown for added equipment and rooftop unit.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

3.4 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.5 FIELD QUALITY CONTROL

- A. 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. 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. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 - 3. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" 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.
- C. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- D. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.6 SYSTEM PROGRAMMING

- A. Allow for 2 programming modifications to be provided as part of the construction phasing plan and the final coordination of the system installation. Provide programming modifications as directed by the Architect.

END OF SECTION

SECTION 31 12 01

SITE PREPARATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

The general provisions of the Contract, including General and Supplementary Conditions and General Requirements (if any), apply to the work specified in Division 31, 32 and 33.

1.02 DESCRIPTION OF WORK

- A. The extent of site preparation is shown on the drawings.
- B. Site preparation work includes, but is not limited to, the following:
 - 1. Site investigation and underground utility identification
 - 2. Protection of existing trees, shrubs, ground covers and lawns to remain
 - 3. Topsoil stripping and stockpiling on site (See Section 32 92 01)
 - 4. Site clearing and removals
 - 5. Asphalt milling
 - 6. Saw cutting
 - 7. Relocations/salvaged materials
 - 8. Clean up
- C. Provide materials, labor, equipment and services required to accomplish related work in accordance with the drawings and specifications.

1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 31 22 01 - Site Earthwork
- B. Section 32 92 01 - Lawns
- C. Section 33 40 01 - Storm Drainage

1.04 SITE INVESTIGATION

- A. The Contractor shall visit the site before bidding, inform and familiarize themselves of all site conditions, including but not limited to, site topsoil, sub-soil, rock, subsurface and groundwater conditions affecting proposed work. No allowance or additional cost will be made in the work of this contract for failing to determine overall project site conditions.
- B. Verify locations and protect utilities and structures, whether or not shown on the drawings. Existing utilities and structures shown on the drawings are for the Contractor's convenience and locations are not guaranteed.
- C. Verify survey information given on drawings. Walk the site with the Owner's Facilities Management Personnel to discuss approximate locations of reputed utilities not shown on the survey, prior to performing work. Notify the Architect of any and all discrepancies prior to commencing work. Commencement of work will be construed as complete acceptance of survey information.
- D. Locate and protect from disturbance existing survey monuments, pins, markers and benchmarks whether or not shown on drawings. When any disturbance or damage

occurs, notify Architect in writing within 24 hours. Describe nature of disturbance or damage and date first occurred. Provide copies to applicable government and municipal agencies. Pay costs for restoring monument to satisfaction of said agencies, at no additional expense to the Owner.

1.05 JOB CONDITIONS

- A. The terms "Architect" and "Landscape Architect" for Divisions 31, 32 and 33 work shall mean Appel Osborne Landscape Architecture, 102 West Division St., Suite 100, Syracuse, NY 13204, Tel. (315) 476-1022, Facsimile (315) 479-7573, or other representative(s) that MARCH Associates may determine.
- B. Examine drawings and specifications for the entire project. Become familiar with the scope and sequencing of work required. Coordinate and cooperate with other Contractors and trades working in and adjacent to the project.
- C. Examine work prepared prior to this contract. Commencement of work will be construed as complete acceptance of all preparatory work by others.
- D. Obtain and pay for permits required by authorities. Perform the work in compliance with applicable standards, codes and requirements of governing authorities having jurisdiction.
- E. Safety is the sole responsibility of the Contractor.
- F. Burning on site and use of explosives are not permitted.
- G. Responsibility for existing utilities:
 - 1. Contact Dig Safely New York at least two (2) full working days, and not more than ten (10) working days, before digging begins or as required by latest state law. Locate by hand excavation and provide protection from damage to existing utilities to remain in the area. (Tel. 811)
 - 2. Existing utilities encountered within excavated areas shall be supported, blocked and/or braced in a manner approved by the owner of the utility. Leave supports in place to the extent required by the owner of the utility.
 - 3. Should uncharted or incorrectly charted utilities be encountered, notify the Architect immediately for directions as to procedure.
 - 4. Do not break utility connections without providing temporary services as acceptable to the Architect and the owner of the utility.
 - 5. Repair and pay for damages to existing utilities as directed by utility Owner at no additional cost to the Owner.
 - 6. Cap ends of utilities to be abandoned or removed in accordance with regulatory agencies and as directed by the Architect.
- H. Provide protections and conduct operations to prevent injury and damage to persons, work of other Contractors, existing items to remain, structures, pavements, lawns, and adjacent properties.

- I. Restore work damaged by this Contractor inside and outside the contract limits to the condition existing prior to the start of work, unless otherwise directed, to the satisfaction of the Architect at no additional cost to the Owner.
- J. Vehicular and pedestrian traffic control:
 - 1. Maintain vehicular and pedestrian traffic during construction activities.
 - 2. Provide alternate routes and traffic control around closed and obstructed traffic ways as required by governing regulations or the Owner.
 - 3. Provide temporary fencing, flagpersons, barricades, warning signs, and warning lights or other measures to protect the public and cause the least interruption of work.
- K. Field Measurements: Take necessary field horizontal and vertical measurements required in order to perform the work and design intent shown on the drawings, and outlined in the specifications. Assume complete responsibility for accuracy of such measurements and dimensions.
- L. Removal of spoils, dust control, debris, snow and clean up:
 - 1. Control air pollution caused by dust and dirt; comply with governing regulations. Water to control dust when necessary and as directed by the Architect or Certified Erosion Control Specialist. Provide water sprinkling materials, equipment and labor to prevent the nuisance of dust to the surrounding areas.
 - 2. Legally dispose of removed and demolished items, including trash and debris, off the Owner's property, at a licensed disposal facility having adequate capacity to accept the project's waste.
 - 3. Burning of combustible materials on the site is not permitted.
 - 4. During the contract and at intervals as directed by the Architect, clear the site of extraneous materials, rubbish, construction waste, and debris. Leave the site in a clean, safe, neat, well-draining condition.
 - 5. Soil Removal: Sweep roads, access ways, paved areas, and parking areas where soil, mud and debris have dropped or tracked from construction and delivery vehicles on a daily basis and as directed by the Architect or Certified Erosion Control Specialist.
 - 6. Spoils: Remove from site and dispose when not required for fill or determined to be unsatisfactory soil material per Section 31 22 01 - Site Earthwork.
- M. Construction Review - General: Site visits will be made by the Architect to observe construction conformance to drawings and specifications. The occasional site visits by the Architect shall not be construed as supervision of construction or make them responsible for the safety programs and precautions, including but not limited to: the safe access, visit, use, work travel, or occupancy of any person. Site visits shall not make the Architect responsible for means, methods, techniques, sequences or procedures of construction selected by the Construction Manager, Contractor or his Sub-contractors.
- N. Site Complexity: The existing site will be intensively developed. Because of the construction and resulting graphic complexity, it is impractical to show every detail. However, the general design intent is clearly shown and shall be applied to individual

conditions not specifically shown as directed by the Architect and at no additional cost to the Owner.

- O. Asbestos, Toxic and Hazardous Materials: The Division 31, 32 and 33 site work contract does not include testing for, handling or removal of hazardous materials such as, but not limited to: asbestos, fuel, oil, PCB's, or other toxic or hazardous waste materials as identified by the EPA and/or NYSDEC. If any such materials are encountered during any part of the site work, the Contractor is responsible for identifying potential hazardous material and immediately notify all governing agencies having jurisdiction as required by law. Also, within one (1) hour of discovery notify the Architect, Landscape Architect, Consultants, and Owner. The Owner shall provide testing and removal by others, under separate contract. The Contractor shall recommence work under this contract when the Owner provides written certification that remediation is complete per governing agency. The Contractor shall not be penalized for any delays caused by the hazardous testing and removal, unless such hazardous material incident was a result of Contractor's operations. The Contractor shall indemnify and hold harmless the Architect, Landscape Architect, Consultants and Owner, agents, and employees from and against all claims, damages, losses and expenses, direct and indirect or consequential damages, including but not limited to fees and charges of attorneys and court and arbitration costs, arising out of or resulting from the performance of the work by the Architect, Landscape Architect, Consultants and Owner, or claims against the Architect, Landscape Architect, Consultants and Owner arising from the work of others, related to hazardous waste.

The above indemnification provision extends to claims against the Architect, Landscape Architect, Consultants and Owner which arise out of, are related to, or are based upon, the dispersal, discharge, escape, release or saturation of smoke, vapors, soot, fumes, acids, alkalis, toxic chemicals, or pollutant in or into the atmosphere, or on, onto, upon, in or into the surface or subsurface soil, water or water courses, objects, or any tangible or intangible matter, whether sudden or not.

Should the hazardous material incident be the result of the Contractor's operations, the Contractor shall be responsible for all costs associated with the discovery and remediation of such hazardous material such as, but not limited to: testing, consultant fees, damage, loss, fees and charges of attorneys, court and arbitration costs, claims by other contractors, direct and indirect or consequential damages.

- P. Salvageable Items: Remove at any time after work starts. Storage or sale on site of salvageable and removed items is not permitted. Do not remove topsoil from site without written permission from the Owner.
- Q. SUBMITTALS/PROCEDURES: Submit Tests, Shop Drawings, Material Certificates (showing content/mechanical analysis) and Manufacturer's Product Data (MPD) to Architect for review a minimum of two (2) weeks prior to installation.
1. Provide a minimum of five (5) copies from material producer or laboratory, stamped as checked and approved by the Contractor before submittal to the Architect or as otherwise indicated in Division 1. (Note: Electronic submittal process may be acceptable when approved by the Owner and Architect.)
 2. Refer to individual specification sections for a list of required submittals.
 3. For each material certificate required, provide certification by an Architect approved independent testing laboratory which gives analysis results and states that the material complies with or is superior to the specified requirements.

1.06 SUBMITTALS: (See 1.05, above)

- A. Provide photographic documentation. Photographically document existing features which, may be affected by the construction, inside and outside the contract limit line. Existing features include, but are not limited to: structures, pavements, curbs, utilities, lawns and vegetation, especially individual trees which are over six (6") inches in diameter and noted to remain on the drawings. Also, particular attention shall be paid to the construction access, stockpile and haul road areas. Distribute a copy of the photographic documentation (color prints or digital format) to the Owner and Architect prior to the start of construction.

PART 2 - PRODUCTS

2.01 PROTECTIVE DEVICES

- A. Shall include, but not be limited to; plastic fence, chain link fence and gates, wood planks, rubber mats, barriers, lights, barricades, coverings, traffic controls, steel plates, and other temporary protections. Contractor to provide all necessary protections required by Occupational Safety and Health Administration (OSHA).

PART 3 - EXECUTION

3.01 PROTECT EXISTING VEGETATION TO REMAIN

- A. Prior to commencing site preparation work, notify Architect, and meet on site to locate existing trees, lawns and vegetation which are to remain.
- B. Protect and keep existing vegetation to remain free from physical damage. Keep in a healthy, vigorous growing condition for the entire construction period as follows:
 - 1. Keep site disturbance and staging limits to a minimum. Obtain approval from Owner for material and equipment storage areas. Limit access points and routes to the project site. Coordinate site access with other trades and contractors on the work site.
 - 2. Groups of Trees and Vegetation: Place orange plastic construction fencing around drip line(s) of trees and plant beds as detailed or directed by the Architect. Do not store materials, run equipment, park vehicles, or otherwise disturb area within the drip line (full canopy of tree) or in plant beds.
 - 3. Specimen and Individual Trees: Protect each as noted and detailed. Do not store materials, run equipment, park vehicles or otherwise disturb area within the drip line (full canopy of tree).
- C. Rejuvenate damaged vegetation by pruning watering, fertilizing, staking and other methods as directed by the Architect. Replace trees and other vegetation that cannot be restored to full growth with comparable size, quantity, quality and species as determined by the Architect.
- D. Repair lawns disturbed due to construction operations outside the grading limits, as specified and directed by the Architect. Provide screened topsoil, seed, and mulch over damaged lawn areas, access ways or where tire rutting occurred.

3.02 TOPSOIL STRIPPING AND STOCKPILING ON SITE

- A. Strip full depth of existing topsoil from areas to be regraded, paved, or otherwise built upon. When amount of available topsoil exceeds what is indicated in geo-tech/boring

report, on site test pits, or Contractor assumed depth, continue to remove all topsoil and lower the paved or built element subgrade. Place additional satisfactory earth fill in uniform depths as indicated in the Site Earthwork Section 31 22 01. Maintain finished grades as shown on the drawings. This work shall be done at no additional cost to the Owner.

- B. Minimum quantity of topsoil shall be as needed to provide four (4") or six (6") inches settled depth on lawn areas. Verify quality and quantity. Supply imported topsoil when amount of available topsoil meeting above requirements is less than what is required for the proposed lawn areas. See Section 32 92 01 for imported topsoil requirements.
- C. When amount of available topsoil meeting above requirements exceeds what is required for the proposed lawn and athletic field areas, lower the lawn and athletic field subgrade and place additional topsoil in a uniform depth as directed by the Architect. Maintain finish grades as shown on the drawings. This work shall be performed and supplied at no additional cost to the Owner.
- D. Topsoil shall be well drained, homogeneous texture soil of uniform grade, without the admixture of subsoil material. Topsoil shall be free of dense material, hardpan, and stone over three-quarters (3/4") inch in diameter, and other objectionable foreign material including, but not limited to, brick, concrete, asphalt, glass, nails, screws, toxins, hazardous wastes and chemicals (such as, but not limited to, atrizene and muriatic acid) that may be injurious to humans, animals and plant materials.
- E. Stockpile on site where shown on the drawings or as directed by the Owner. Provide all hauling as necessary. Do not mix topsoil stockpiles with other materials. Do not remove topsoil from site without written permission by the Owner. Stabilize and maintain all stockpiles as specified.

3.03 SITE CLEARING AND REMOVALS

- A. Items and materials noted to be removed shall become the property of the Contractor, unless otherwise noted. Obtain Owner's approval prior to removal off site or for relocation of salvaged material on site. Remove material off site and legally dispose of it. Backfill voids with imported granular backfill, placed in eight (8") inch layers compacted to 95% maximum density.
- B. Remove physical elements above and below grade as shown and which interfere with proposed construction. Physical elements include but are not limited to: trees, root systems, shrubs, vines, grass, vegetation, pavements, walks, curbs, gutters, foundations, previous construction materials, glass, headwalls, flared end sections, catch basins, manholes, inlets, drywells, septic tanks, unused utilities, pipes, cisterns, walls, rocks, and other debris.
- C. Trees, shrubs and roots shall be completely removed and disposed of legally off site.
- D. Maintain existing utilities shown to remain and protect from damage during demolition and construction operations. Do not interrupt existing utilities; provide temporary services when required, as acceptable to the Architect.
- E. Research with Owner possible locations of existing subsurface utilities prior to excavating.

3.04 ASPHALT MILLING

- A. Mill existing asphalt to limits shown on the drawings and dispose off site.

- B. The Contractor shall use equipment with automatic grade and slope controls, capable of cold milling existing asphalt pavement to an accurate depth of cut, profile and cross slope and shall be capable of loading the milled material directly into trucks.
- C. Cold milling asphalt pavement shall be performed in a manner which prevents the tearing and breaking of underlying and adjacent pavement and the contamination of the millings with granular subbase material, subgrade or deleterious materials. All millings shall be loaded directly to trucks from the milling machine and hauled to stockpile or disposed of.
- D. The milled surface shall be swept and jet washed clean prior to installation of new surface material. The Contractor shall sweep the surface in a manner which minimizes dust.
- E. The Contractor shall promptly repair any and all localized areas of distress in the milled surface that may present a hazard to traffic, the finished surface, the stability of the new asphalt, or deemed unsuitable by the Architect, at no additional cost to the Owner.
- F. Contractor shall apply NYSDOT approved tack coat to the cleaned, milled surface in preparation to received new top course asphalt as specified in Section 321201 - Asphalt Paving.

3.05 SAW CUTTING

- A. The Work consists of vertical saw cutting of the existing asphalt or concrete pavement structure to facilitate the removal of the asphalt or concrete bound material.
- B. The equipment shall be capable of producing a smooth vertical saw cut without causing damage to the adjacent pavements or related site features.
- C. The Contractor shall saw cut the asphalt/concrete pavement to a depth which will allow removal of the material without causing damage to the adjacent pavement. Rough, jagged or cracked edges will not be acceptable. Concrete pavement shall be removed at the nearest contraction joint.

3.06 RELOCATIONS

- A. Any item noted to be relocated shall be removed by the Contractor from its existing position without damaging it, stored, protected from theft, fire, vandalism and damage for the project duration. Reset in the location(s) and in the manner detailed, noted on the drawings or specified.
- B. Backfill voids with imported granular fill material, placed in eight (8") inch layers compacted to 95% maximum density when located in proposed pavement areas or 90% maximum density when located in proposed non-paved areas.
- C. Salvaged items shall be returned to the Owner as noted on the drawings. Move items to Owner designated areas.

3.07 CLEAN UP

During the contract and at intervals as directed by the Architect and as site preparation is completed, clear the site of extraneous materials, rubbish, and debris. Leave the site in a clean, safe, well draining, neat condition.

END OF SECTION

SECTION 31 22 01

SITE EARTHWORK

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. The extent of site earthwork and site grading is shown on the drawings.
- B. Site earthwork includes, but is not limited to, the following:
 - 1. Fill Materials
 - 2. Source Quality Control
 - 3. Shoring, Bracing and Supporting
 - 4. Horizontal and Vertical Layout
 - 5. Grading and Excavation
 - 6. Compacted Backfill and Fill
 - 7. Stone Blanket(s)
 - 8. Field Quality Control Testing and Inspection Services
 - 9. Guarantee
 - 10. Clean Up
- C. Provide materials, labor, equipment and services required to accomplish related work in accordance with the drawings and specifications.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 31 12 01 - Site Preparation
- B. Section 31 25 01 - Erosion, Sediment and Pollution Control
- C. Section 33 40 01 - Storm Drainage

1.03 REFERENCES

- A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; American Association of State Highway and Transportation Officials
- B. ASTM C 136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- C. ASTM D 75 - Practice for Sampling Aggregates
- D. ASTM D 422 - Particle-Size Analysis of Soils (without Hydrometer Analysis)
- E. ASTM D 698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³)
- F. ASTM D 1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³)
- G. ASTM D 2434 - Standard Test Method for Permeability of Granular Soils (Constant Head)
- H. ASTM D 2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

- I. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
- J. ASTM D 3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
- K. ASTM D 6938 - In Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods
- L. ASTM D 4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- M. ASTM D 5084 - Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.
- N. Deep Ripping and Decompaction shall be per NYSDEC recommendations, latest edition
- O. Occupational Health and Safety Administration Regulations and Standards
- P. American Sports Builders Association (ASBA): Sports Fields - A Construction and Maintenance Manual, latest edition
- Q. ASTM F2898-11 – Standard Test Method for Permeability of Synthetic Turf Sports Field Base Stone and Surface System by Non-Confined Area Flood Test Method

1.04 SUBMITTALS (See Section 31 12 01, 1.05)

- A. Furnish name of New York State licensed Land Surveyor to be employed and perform project layout. Obtain Architect's approval prior to performing work.
- B. Submit written report on NYS licensed Land Surveyor's letterhead verifying that professional's involvement with the project layout. The report shall briefly state the scope of services performed for the project, the dates work was accomplished and an explanation of any adjustments required, specifically listing as-built and FIELD VERIFY requirements as noted in 3.02 of this specification section.
- C. Provide Earthwork Contractor's experience requirements as indicated in 1.05, "Quality Assurance". Obtain Architect's approval prior to performing work.
- D. Samples: 10 lb. samples of each type of fill; submit in airtight containers to testing laboratory.
- E. Materials Sources: Submit name of imported materials source for each type of fill material.
- F. Fill Composition Test Reports (Imported and Onsite): Provide results of laboratory tests (less than 2 months old) on proposed and actual materials used to determine acceptability. This shall include:
 - 1. One optimum moisture-maximum density curve (Modified Proctor) for each soil/imported fill type as determined by ASTM D1557, Method A, latest issue.
 - 2. Sieve Analysis - ASTM D422
 - 3. Moisture Density Relationship - ASTM D1557, Method C / ASTM D698
 - 4. Plasticity Index - ASTM D4318
 - 5. Soundness Test - ASTM C88

- 6. Soil Classification - AASHTO and ASTM D2487
- G. Compaction Density Test Report(s) required in Field Quality Control of this specification.
- H. Contractor's NYS Licensed Professional Engineer's layout and design calculations of sheet piling and shoring required.
- I. Synthetic Turf Permeability Testing: Engage an independent testing agency to perform ten (10) permeability test of both the finishing stone and base stone of proposed synthetic turf stone blanket as determined by ASTM D2434 and ASTM F2898-11. Results shall meet the following at minimum:
 - 1. permeability of base stone ≥ 40 "/hour
 - 2. permeability for finishing stone ≥ 40 "/hour

1.05 QUALITY ASSURANCE

- A. Perform all site earthwork, site grading and excavation in compliance with requirements of governing authorities having jurisdiction, OSHA Standards, and "References" in this project specification.
- B. The Owner will employ a licensed soil testing and inspection service for Field Quality Control Testing of materials. This Contractor will coordinate day to day scheduling with the Owner's testing agency for conformance with "Field Quality Control Testing and Inspection Services" in this project specification.
- C. Earthwork Contractor Experience Requirements: Submit business name, business Owner(s) name(s), business address, telephone number, website and/or email address signed by the Contractor/Subcontractor who meets the qualifications set forth in this specification and is proposed by the Contractor to perform the Earthwork for this Project. Provide a list of at least four (4) Earthwork projects of comparable size, scope and quality completed successfully by the proposed Contractor/Subcontractor within the past three (3) years that includes the date completed, project Owner's name and current contact information, including telephone numbers and email addresses.
- D. Layout Foreman Experience: The Earthwork Contractor must provide a competent layout foreman skilled in this specific type of layout/earthwork project. The layout/earthwork foreman shall have a minimum of four (4) similar projects completed within the last three (3) years. Provide a list of projects layout/earthwork foremen has completed including project name, address, Owner contact information and project scope of work.

1.06 JOB CONDITIONS

- A. Job conditions in Section 31 12 01 apply.
- B. Provide sufficient quantities of fill materials to meet project schedule and requirements. When necessary, store materials on site in advance of need.
- C. When fill materials need to be stored on site, locate stockpiles where directed by Owner.
 - 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
 - 2. Prevent contamination of material types.
 - 3. Protect all stockpiles from erosion and deterioration of materials by covering with plastic sheets, tarps or as directed by the Architect.

- D. Moisten or dry, fill or backfill materials, to the proper moisture content as determined in accordance with ASTM D1557, Method C in order to obtain proper compaction as indicated.

1.07 SUB-SURFACE SOIL INFORMATION

- A. Refer to subsurface information elsewhere in the specifications. The geo-technical data on subsurface conditions is not intended as representation warranties of the continuity of such conditions between test pits or test borings made by the Owner and included in the specification. It is expressly understood that the Owner, Architect, Landscape Architect, and Consulting Engineers are not responsible for interpretations or conclusions drawn therefrom by the Contractor. The data is made available for the convenience of the Contractor.
- B. Additional test borings and other exploratory operations may be made by the Contractor at no additional cost to the Owner, provided such operations are acceptable to the Architect and Owner. Coordinate test locations with Owner prior to starting work. Backfill immediately when completed and repair to satisfactory conditions as determined by the Architect. It is expressly understood that the Owner, Architect, Landscape Architect, and Consulting Engineers are not responsible for interpretations or conclusions drawn therefrom by the Contractor.

1.08 UNUSUAL SUBSURFACE CONDITIONS

- A. Notify the Architect immediately in writing via email when unusual conditions are encountered during excavation, including, but not limited to: excessive flooding, miscellaneous structures, uncharted or unlocated utilities, foundations, bed rock, toxic and hazardous materials and chemicals (such as muriatic acid and atrizene), suspected archaeological artifacts, and unsatisfactory soil materials. Request clarification from the Owner's Representative or Architect before proceeding. Refer to paragraph 3.4 of this specification.

PART 2 - PRODUCTS

2.01 FILL MATERIALS

- A. **Satisfactory General Earth Fill:**
 - 1. To be used at least 5'-0" outside of structural elements, running track, field events and synthetic turf subgrade areas.
 - 2. Satisfactory general earth fill shall be satisfactory on-site subsoil, or hauled in off-site subsoil free of toxics, hazardous wastes and chemicals (such as, but not limited to, atrizene and muriatic acid) that may be injurious to humans, animals and plant materials. Satisfactory earth fill shall also be free of rubbish, debris, wood, masonry, metal, frost, vegetation, organics or other deleterious material, which cannot be properly compacted. Use satisfactory general earth fill that is dry and free of clay. Rocks, gravel or soil shall not be larger than 3" in any dimension/direction.
 - 3. Satisfactory earth fill materials are also defined as those complying with the American Association of State Highway Transportation Officials (AASHTO), M-145 soil classification Groups A-1, A-2-4, A-2-5, A-3 and Unified Soil Classification System GW, GP, GM, GC, SW, SP, SM, and SC (or a combination of these group symbols) as determined by ASTM D2487.

B. Imported Granular Backfill:

1. Imported granular backfill to be used for asphalt pavement subbase, concrete subbase, storm structures, storm pipes, water pipes, sanitary manholes, sanitary pipes, other structures, and where indicated on the drawings.
2. Backfill shall be run of crusher limestone meeting the following gradation as determined by ASTM-C136:

<u>Standard Sieve Sizes</u>	<u>Percent Passing By Weight</u>
2" or 50 mm	100%
3/4" or 19 mm	75 - 90%
1/4" or 6.3 mm	25 - 60%
#40 or 0.425 mm	5 - 40%
#200 or 0.075 mm	0 - 8%

3. Backfill shall be free of debris and deleterious materials. In no case shall the plasticity index exceed 5.0 or the percentage passing the 200 mesh sieve exceed 8%. The quality of the imported granular backfill shall be determined by the magnesium sulfate soundness test, if considered suspect by the Architect or Geotechnical Engineer. The maximum percent loss at four cycles by weight shall be 20.

C. Imported Structural Fill:

1. Imported structural fill to be used in areas of structural elements, for top eight (8") inches of design subgrade elevation for running track, field events, synthetic turf fields and where noted on the drawings.
2. Shall be run-of-crusher limestone free from organic matter or other deleterious materials, meeting the material gradation requirements of Item 304.05 Sub-base Course, Type 4, of the NYSDOT's Standard Specifications for Construction Materials, as determined by ASTM C136.

<u>Standard Sieve Sizes</u>	<u>Percent Passing By Weight</u>
2" or 50 mm	100%
1/4" or 6.3 mm	25 - 60%
#40 or 0.425 mm	5 - 40%
#200 or 0.075 mm	0 - 8%

3. Imported structural fill shall be accepted on the basis of gradation, soundness, plasticity index and a well-defined Moisture-Density Relationship Curve. Imported structural fill to be placed within 8" of final exterior subgrade shall be subject to Soundness requirements. Soundness shall be less than 30% loss based on a four-cycle magnesium sulfate soundness test. Plasticity Index of that portion of fill material passing the No. 40 mesh sieve shall not exceed 5.0.

D. Stormwater Management Trench (SMT) Backfill:

1. Shall be No. 1 clean, washed, crushed stone or crushed gravel meeting the following gradation as determined by ASTM C136:

<u>Standard Sieve Size</u>	<u>Percent Passing By Weight</u>
1" or 25.0 mm	100%
1/2" or 12.5 mm	90-100%
1/4" or 6.3 mm	0-15%

E. Vertical Drain Backfill:

1. Shall be clean, coarse concrete sand, meeting the following gradation as determined by ASTM C136:

<u>Standard Sieve Sizes</u>	<u>Percent Passing By Weight</u>
3/8" or 9.5 mm	100%
#4 or 4.75 mm	75 - 90%
#16 or 1.18 mm	30 - 45%
#50 or 0.3 mm	5 - 10%
#100 or 0.15 mm	2 - 5%

F. Stone Blanket (For Ball Infields):

1. Shall be crushed stone or crushed gravel meeting the following sieve gradation as determined by ASTM C136:

<u>Standard Sieve Sizes</u>	<u>Percent Passing by Weight</u>
1-1/2" or 38.0 mm	100
1" or 25.0 mm	95 - 100
3/4" or 19.0 mm	80 - 100
1/2" or 12.5 mm	60 - 80
3/8" or 9.5 mm	30 - 50
No. 4 or 4.75 mm	20 - 40
No. 8 or 2.36 mm	10 - 30
No. 16 or 1.18 mm	2 - 25
No. 40 or 0.425 mm	5 - 17
No. 200 or 0.075 mm	0 - 4

2. Soil Separation Fabric: Shall be commercially manufactured non-woven polypropylene filter fabric. Standard of quality shall be Mirafi 140N as manufactured by TENCATE or Architect approved equal.

G. Stone Blanket (For Synthetic Turf):

1. Material shall be a 100% fractured, by mechanical means, with elongated characters on each individual particle larger than 1/4". Material shall be clean of mineral fines with particles smaller than 1/4" by manufactured means. Rounded sands and crushed gravels are prohibited.
2. Shall be crushed hard durable limestone meeting the following gradation as determined by ASTM C136:

<u>Standard Sieve Sizes</u>	<u>Base Stone Percent Passing by Weight</u>	<u>1/2" Max. Depth Finishing Stone Percent Passing by Weight</u>
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1-1/2" or 38.0 mm	100	-
1" or 25.0 mm	95 - 100	-
3/4" or 19.0 mm	80 - 100	-
1/2" or 12.5 mm	60 - 80	100
3/8" or 9.5 mm	30 - 50	95 - 100
No. 4 or 4.75 mm	20 - 40	70 - 85
No. 8 or 2.36 mm	10 - 30	45 - 60
No. 16 or 1.18 mm	2 - 25	25 - 40
No. 40 or 0.425 mm	5 - 17	2 - 12
No. 200 or 0.075 mm	0 - 4	0 - 3

3. Delivery Moisture Content: Processed stone must contain 90% to 110% of the optimum moisture content to ensure that fines do not migrate and to facilitate proper compaction. The Contractor shall ensure aggregate leaving the source plant meets this requirement and shall be required to apply water to the processed stone on site if necessary to achieve the minimum moisture content.
4. Stone blanket stone shall be free of debris and deleterious materials. In no case shall the plasticity index exceed 5.0 or the percentage passing the 200 mesh sieve exceed 4%. The quality of the stone blanket shall be determined by the magnesium sulfate soundness test, if considered suspect by the Architect or Geotechnical Engineer. The maximum percent loss at four cycles by weight shall be 20.
5. Soil Separation Fabric: Shall commercially manufactured non-woven polypropylene filter fabric. Standard of quality shall be Mirafi 140N as manufactured by TENCATE or Architect approved equal.
6. Mechanical analysis of base and finishing stone shall be reviewed and approved by both the Architect and Turf Manufacturer.

2.02 UNSATISFACTORY SOIL MATERIALS

- A. Shall be defined as soil with high percentage of decomposed rock, sand, organic matter or moisture laden clay to prevent adequate compaction. Also, soil with toxics, hazardous wastes and chemicals (such as atrazine and muriatic acid) that may be injurious to humans, animals and plant materials. Also, soil with significant quantities of rubbish, debris, wood, masonry, metal, frost or other deleterious material which, in the opinion of the Geotechnical Engineer, Owner's Representative, and Architect, cannot be properly compacted shall be classified as unsatisfactory.
- B. Unsatisfactory soil materials are defined as those described in AASHTO M-145, soil classification, Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7 with CBR value less than 7.0. Also Unified Soil Classification System ML, CL, OL, MH, CH, OH as determined by ASTM D2487 (or a combination of these group symbols) with CBR value less than 7.0 in addition to peat (PT) and other highly organic soils, cobbles, boulders; and soil materials, of any classifications that have a moisture content at the time of compaction beyond the range of 1% below and 3% above the optimum moisture content of the soil material/backfill material, as determined by the Moisture Density Relationship test.
- C. When unsatisfactory soil materials are encountered at proposed subgrades and other design elevations, proceed as described in Part 3 (Execution) of this Section.
- D. When excavated materials become unsatisfactory as a direct result of the Contractor's work, this shall result in the rejection of the unsatisfactory soil materials by the Architect.

- E. The use of slag (a byproduct of metal processing) or recycled/crushed concrete is unacceptable for any use on this project site.

2.03 SOURCE QUALITY CONTROL

- A. See "Submittals" and "Quality Assurance" of this specification section for general requirements for testing and analysis of soil and fill materials.
- B. Where fill materials are specified by reference to a specific standard, Contractor is responsible to test and analyze all samples for compliance before delivery to site.
- C. If tests indicate materials do not meet specified requirements, change material and retest until approved.

2.04 SHORING, BRACING AND SUPPORTING

- A. Shoring and bracing shall conform to the requirements of the Occupational Health and Safety Act.
- B. Shoring and bracing shall be provided, placed and maintained at the locations and elevation that are necessary or required to: support and protect the sides and bottom of the excavation; prevent undue disturbance or weakening of the supporting materials below or beside the works; prevent movement of ground which may disturb or damage the work, adjacent pavements, property, structures or other works.
- C. Provide materials for shoring, bracing and supporting, such as sheet piling, uprights, sheathing, stringers and cross-braces, in good serviceable condition. Use timbers that are sound and free of large or loose knots.
- D. Provide design by Contractor's NYS Licensed Engineer, when shoring is required to perform work as shown on the drawings. Submit to Architect for approval.
- E. Installation: Shoring and bracing shall be driven and placed so that it can be removed as backfilling takes place without damage to the pipeline or its appurtenances, structures, and without settlement of or damage to adjacent pavements and structures.
- F. Removal: The Contractor shall remove all shoring and bracing as the excavation is backfilled, unless directed by the Architect to be left in place. The procedure for extracting shoring and bracing and placing backfill shall ensure the backfill load is applied gradually and disturbance of the works or foundation material is avoided.
- G. Support all utilities as required by the municipality/utility owner.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify field conditions such as bench marks, monuments, topography, inverts, locations of utilities and property lines before proceeding. Notify the Architect immediately, in writing, of discrepancies prior to commencing work. Commencement of work will be construed as complete acceptance of survey and layout information. Additional costs resulting from failure to verify field conditions prior to commencing work shall be borne by this Contractor and at no additional cost to the Owner.

3.02 LAYOUT

- A. Stake layout up to and including those elevations and dimensions specifically noted on drawings as "FIELD VERIFY" (FV). Ensure that the field elevation and dimension agrees with the elevation and dimension on the drawings before continuing. Notify the Architect immediately, in writing, of any discrepancies prior to commencing work. Additional costs resulting from failure to verify dimensions as noted on drawings shall be borne by this Contractor and at no additional cost to the Owner.
1. Assume sole responsibility for the accuracy of the layout work.
 2. Run from point(s) of beginning (POB), base lines, property monuments, bench marks, iron survey pins, or other points given on the drawings.
 3. Roads, Parking Areas, and Walks: Accurately locate and stake curblines, center line, swales, point of curve and tangency as necessary to accurately build.
 4. Buildings and Site Features: Accurately locate and stake corners, offset corners, slopes, and center lines as necessary to accurately build.
 5. Pipe Work: Accurately locate with laser.
- B. Athletic Field Layout:
1. Provide accurate layout, alignment and dimensions for fields as shown on drawings and detailed by professional NYS Land Surveyor approved by the Architect.
 2. Accurately locate and stake field corners, subsurface location monuments and backstops. Use Owner approved corner markers or stakes 2" x 2" x 2' long pressure treated wood with 16d common nail set flush in top of stake as metal detection element. Set top of athletic field location stakes flush with adjacent finish grades. Spray paint top of stake with day glow orange paint. Protect during construction. Replace if removed at no additional cost to the Owner. Remove as directed by the Architect.
 3. Temporarily stripe lawn athletic fields with field line marking mixture approved by Owner and correct surface high and low spots as described in Section 32 92 01 prior to seeding or sodding.
 4. Temporarily stripe synthetic turf stone blanket subgrade with field line marking mixture approved by Architect. Meet tolerances described in 3.03 of this specification Section. Correct differences as directed by the Architect.
 5. Temporarily stripe synthetic turf stone blanket surface every five (5) yards across the field with field line marking mixture approved by Architect. Correct surface high and low spots as described in Section 33 40 01 prior to synthetic turf installation.

3.03 GRADING

- A. Cut and Fill: Presume the earthwork does **NOT** balance on site. Meet the grades shown on the drawings. Haul in or haul away as may be necessary. Provide earthwork calculations, and provide for imported or exported material as part of bid. No additional costs will be allowed.
- B. Grade areas as indicated, including transition areas, with uniform levels and slopes between finish elevations.

- C. Cut to grades and profiles indicated.
- D. Set grade stakes at fifty foot (50') intervals, at corners, and breaks in grade.
- E. Conduct operations to avoid ponding of water. Provide all pumping equipment, sump pits, and temporary diversion swales where and when necessary to continue work performance on schedule and as specified.
- F. Shape subgrade surface of site elements to within 0.10' above or below required subgrade elevation, compacted as required and sloped to provide drainage as shown on the drawings. Notify Architect and Geo-Technical Engineer for subgrade review prior to continuing work.
- G. Shape subgrade surface of athletic fields and track areas using laser plane control system for grading of subgrade elevation to ensure accuracy in grade tolerances of +0" to - 1/4" in 10' any direction. Compact as required and sloped to provide drainage as shown on the drawings. Notify Architect and Geo-Technical Engineer for review prior to continuing work.
- H. Refer to Section 31 12 01 for topsoil requirements.

3.04 EXCAVATION

- A. Remove and legally dispose of material encountered to obtain required subgrade elevations, including pavement, obstructions visible on ground surface, underground structures and utilities indicated to be removed.
- B. Sloping and Benching: Follow OSHA recommendations based on soil type to determine slope configurations. Slope the sides of excavations five (5') feet deep and over to the angle of repose of the material excavated; otherwise, shore, and brace where sloping is not possible either because of space restrictions or stability of material excavated.
- C. Bracing and Shoring:
 - 1. Provide bracing and shoring as required in excavations, to maintain sides and to protect structures from settlement.
 - 2. Maintain shoring and bracing in excavations regardless of the time period excavations will be open. Carry down shoring and bracing as the excavation progresses.
 - 3. Remove shoring and bracing before completion of backfilling except where required for structural support or slope stability.
 - 4. The design, installation, and maintenance of such shoring and bracing required to accomplish the above purpose are the sole responsibility of the Contractor.
 - 5. Follow OSHA recommendations for bracing and shoring.
 - 6. Indemnify the Owner, the Landscape Architect, Architect, and the Consulting Engineers against any action arising from damage to existing structures, utilities or injury to persons resulting from the Contractor's actions or failure to act, in carrying out the intent of this section.

- D. Protections: Protect structures, vegetation, utilities, sidewalks, pavements, and other facilities in areas of work. Barricade and secure open excavations and provide warning lights/signage from dusk to dawn each day.
- E. Extent of Excavations: Excavate for structures to elevations and dimensions shown, extending excavation a sufficient distance to permit placing and removal of other work and for review. Trim bottom to required lines and grades to provide solid base to receive concrete or imported granular backfill material.
- F. Unsatisfactory Soil Materials: When unsatisfactory soil materials, as defined in this specification, are encountered at design elevations, immediately notify the Architect in writing by email or other equally expeditious means. Continue as directed by the Architect and Geo-Technical Engineer. When, in the sole opinion of the Architect, conditions are not a result of Contractor's negligence, additional excavation may be directed by the Architect and paid for as a Change Order on a unit price or negotiated price basis in accordance with Contract Documents. This additional excavation shall be measured each day and verified by the Owner's representative and the Contractor's Superintendent. A daily written accounting, attested by both parties, shall be maintained with copies daily to the Architect. No claim for extra compensation will be considered except through the procedure outlined above. Assume **500 c.y.** of undercutting and removals, placement of soil stabilization fabric (SSF) and providing and compacting to 95% density imported granular backfill material in Base Bid. Unit price provided shall be utilized to add to or delete from this assumed quantity to account for actual quantity encountered.
- G. Unauthorized and Over Excavation: Consists of removal of materials beyond required subgrade elevations or dimensions without specific direction of the Architect or Geotechnical Engineer. Unauthorized or over excavation, as well as remedial work directed by the Architect or Geotechnical Engineer, shall be at Contractor's expense. Fill of unauthorized excavations shall be as follows (all at no additional cost to the Owner):
1. Fill the voids created by the removal of materials beyond indicated subgrade elevations with lean concrete (2000 psi). Or;
 2. Extending the indicated bottom elevation of the concrete footing to the lower elevation. Or;
 3. Adding imported granular backfill material compacted to 95% density to proper design elevation and layout as directed by the Architect. Testing agency to perform compaction testing prior to proceeding.
- H. Dewatering:
1. Contractor shall anticipate seasonal variations of soil moisture content and groundwater in the Base Bid as verified by site investigation indicated in Section 31 12 01.
 2. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
 - a. Surface and ground water shall be intercepted and removed before entering excavations. All necessary measures shall be taken. Earth dikes, ditches, or other devices, if required, shall be constructed to prevent such flows.

3. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - a. 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.
 - b. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations.
 - c. Provide and maintain pumps, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.
 4. The Contractor shall at all times provide and maintain proper and satisfactory means and devices (i.e. ditches, temporary pipes, pumps, and/or other temporary construction) for the removal of all water entering the excavations. Water shall be removed as fast as it may collect, in such manner that shall not interfere with the execution of the work or in the proper placing of pipe, structures or other work.
 5. Provide and operate sufficient pumping machinery to keep excavated parts free of water. Dig sump pits when necessary into which the excavation shall be drained. Take care and proper precautions in the use of pumps so that in no case will foundations, footings and utilities already in place or existing foundations, footings of adjacent structures or utilities be undermined or disturbed and erosion occur due to pumping.
 6. Do not discharge pumped materials into any body of water, wetland, adjacent property, road side swales, subsurface storm systems, or any infiltration practices as determined by the Architect. Provide temporary sediment basins, traps, and filter bags for pumped water.
 7. Adjust, repair, replace, or clean all work, surfaces, and property, which may have been affected as a result of any dewatering operation.
- I. Prepare subgrade and twelve (12") inches of existing sub-soils below subgrade elevations in excavated areas to minimum density of 95% in structure, pavement, utility areas, trenches, and 90% under lawn non-paved areas.
- J. Rock and Rock Excavation:
1. Rock Definition: Shall be defined as solid hard material located in ledges, bedded aggregate deposits and unstratified masses, and all natural conglomerate deposits so firmly cemented as to present all the characteristics of solid rock, which must be removed by pneumatic hammers. Rock does not include shale, slate, soft sandstone, hardpan, masonry or concrete rubble, boulders less than three (3) cubic yards, such other rock material which is decomposed, stratified, weathered or shattered, or any material capable of being removed by a well maintained Caterpillar 225 power shovel, D8 Dozer with Ripper, or Architect approved equivalent.
 2. Rock Excavation Administrative Procedures: When encountered, shall be stockpiled for measurement before removal and paid for on a unit price basis in accordance with Contract Documents. Notify Architect immediately of rock discovery prior to performing any rock removal or continued excavation. Rock excavations as defined shall be measured each day and verified by the Owner's

designated representative and the Contractor's on site Superintendent. A daily written accounting, attested to by both parties, shall be maintained with copies daily to the Architect. No claim for extra compensation will be considered except through the procedure outlined above. Contractor to assume **100 c.y.** of rock excavation and removal in Base Bid. Unit price provided shall be utilized to add to or deduct from this assumed quantity to account for actual quantity encountered.

3. Rock Excavation Removal Procedures: Includes removal and disposal of rock. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions.
 - a. 24 inches outside of concrete forms other than at footings.
 - b. 12 inches outside of concrete forms at footings.
 - c. 6 inches outside of minimum required dimensions of concrete cast against grade.
 - d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
 - e. 8 inches beneath bottom of concrete slabs-on-grade.
 - f. 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.
4. Any over excavation due to rock excavation and removal shall be handled as directed under "Over Excavation" in this Section.
5. Contractor has the option to remove existing rock and dispose off-site or crush existing rock and use as satisfactory general earth fill when it meets gradation noted in 31 22 01 for imported granular backfill material.

3.05 BACKFILL AND FILL

- A. Preparation of Ground Surface to Receive Fill: Remove vegetation, organic materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Break up and remove existing foundations, concrete slabs, abandoned utilities, and site features. Plow, strip, roughen, or break up slopes steeper than 1 vertical to 4 horizontal so that fill material will bond to existing surface.
- B. Execute these steps when the existing ground surface, after removal of the above unsatisfactory soil materials, has a density less than that specified under "Compaction" for the particular area classification: Break up the ground surface, pulverize, moisture-condition to the optimum moisture content, and compact to the required depth and percentage of maximum density.
- C. In no case shall fill be placed on a subgrade that is wet, muddy, rutted, spongy, frozen or that contains frost or that has not been tested and approved to achieve satisfactory results.
- D. Areas to receive any fill or backfill should be properly prepared, proof rolled, tested per "Field Quality Control" within this specification, inspected and approved by the Architect and Geo-Technical Engineer prior to the placement of fill.

- E. Following grade approval by the Architect and Geo-Technical Engineer, place imported granular backfill, imported structural fill and satisfactory general earth fill material in layers not more than eight (8") inches in loose depth in a manner to minimize segregation. The fill shall be placed in nearly horizontal lifts commencing at the lowest fill area elevation and proceeding with each lift upward and outward from the lower lift.
- F. Moisture Content: Contractor shall anticipate seasonal variations of all soils (on site or imported) and imported fills moisture content in the Base Bid and timing required for such shall be included in the project schedule. The moisture content of the materials shall be adjusted prior to application of compaction such that it is no more than 1% below or 3% above the optimum moisture content of the material. Apply water to surface, subgrade or layers of soil material when required to achieve compaction densities stated below. Remove and replace, or scarify and air dry, soils or imported materials that is too wet to permit compaction to specified density.
- G. Compaction:
 - 1. Compact each eight (8") inch layer of fill and backfill materials.
 - 2. Compact fill and backfill material below subgrade for structures, slabs, pavements, and utilities to minimum 95% of optimum in place density as determined by ASTM D1557, Modified Proctor.
 - 3. Compact fill material below subgrade for lawns or unpaved areas to minimum 90% of optimum in place density as determined by ASTM D1557, Modified Proctor.
- H. Equipment:
 - 1. Use sheepsfoot rollers, pneumatic tired rollers, drum rollers, vibrating tampers, and other compaction equipment capable of obtaining the required density throughout the entire layer being compacted.
 - 2. Use power-driven hand tampers for compacting materials adjacent to site structures.
 - 3. For utility trenches or other confined areas, small compaction equipment may be necessary such as a vibratory plate, jumping jack or walk-behind vibratory roller. In these cases, lift heights no greater than six (6") inches should be maintained.
- I. Reconditioning Compacted Areas: Where previously completed compacted areas are disturbed by subsequent construction operations (by any Contractor), traffic or adverse weather, scarify and dry out the surface, regrade, and recompact to the required density prior to further construction at no additional cost to the Owner. Use hand tamping for recompaction over underground utilities and trenches.

3.06 STONE BLANKET (FOR BALL INFIELDS)

- A. Install perimeter stormwater management trenches (SMT's) with fittings to pipe stubs proposed to receive flat drains.
- B. Prepare subgrade under the stone blanket to a smooth, firm, well draining surface parallel to the finish grade. Install geotextile fabric, overlapping rolls a minimum of 24" at all seams. Install flat drains and connect as shown on the drawings.
- C. Secure all connections with waterproof PVC tape.

- D. Shape the final surface of the processed stone to receive the clay infield mix and continue until the deviation from the required elevation does not exceed a maximum deviation from grade of +0" to -1/4" in ten feet (10'), when measured in any direction using a 10' straight-edge.
- E. Engage testing agency to proof roll wherever possible and mark "soft spots" for additional compaction. Use static tandem drum-type roller of not less than five (5) tons weight. Repair or replace areas that do not pass proof rolling test as directed by the testing agency.
- F. Test percolation rate in three (3) areas and modify stone blanket as directed by the Architect prior to proceeding further.
- G. Install screened topsoil or clay infield mix over the stone blanket as indicated on drawings.

3.07 STONE BLANKET (FOR SYNTHETIC TURF)

- A. Prepare subgrade under the stone blanket to a smooth, firm, well draining surface, sloped as detailed. At no time shall the subgrade be rutted by construction traffic including during the stone blanket material installation. Install geotextile fabric, overlapping rolls a minimum of 24" at all seams. Install and secure flat drains into perimeter SMT with welded couplers as shown on the drawings. Secure all coupler connections with waterproof PVC tape.
- B. Handling and Placement:
 - 1. Prior to stone blanket material placement, remove any excess or contaminated backfill from the stormwater management trenches (SMT's), flat drains, and/or geotextile fabric as directed by the Architect.
 - 2. Should any separation of the materials occur during any stage of the spreading or stockpiling, the Contractor must immediately remove and dispose of segregated material and correct or change handling procedures to prevent any further separation.
 - 3. Utilize a laser plane control system for the grading of the processed stone to ensure accuracy in the grade tolerances of +0" to -1/4" in 10'-0" (measured in any direction).
 - 4. Install processed stone base, from sideline toward center-line, parallel to the flat drain network, to the lines and grades shown on the drawings. Under no circumstances shall the material be pushed more than 30' from the point of discharge. Each layer must be spread uniformly with equipment that will not cause perceptible separation in gradation (segregation of the aggregates), preferably a self-propelled paving machine or laser controlled low ground pressure (LPG) dozer.
 - 5. Shape the final surface of the processed stone to receive the turf system component and continue until the deviation from the required elevation does not exceed a maximum deviation from grade of +0" to -1/4" in ten feet (10'), when measured in any direction using a 10' straight-edge.
 - 6. Engage testing agency to proof roll wherever possible and mark "soft spots" for additional compaction. Use static tandem drum-type roller of not less than five

(5) tons weight. Repair or replace areas that do not pass proof rolling test as directed by the testing agency.

7. The stone blanket shall be compacted to a density of not less than 92% density as determined by ASTM D698 and D2922 measured using a nuclear density method. Engage testing agency to perform required density tests on the installed stone blanket or as directed by the Architect.
8. Install finishing stone and roll tight to achieve a compacted density of not less than 92% so that the surface shall not deviate more than 1/4" in 10' (measured in any direction) when placed under a 10' foot straight edge. This tolerance is required over the entire field.
9. On the completed stone blanket, install temporary painted lines fifteen (15') feet on center approximately on the 5 yard line and review for proper planarity. Perform "string grading" check along these 5 yard lines in the presence of the Architect and Turf Installer. Adjust high and low areas with similar stone blanket material as directed by the Architect and Turf Installer prior to placement of the turf.
10. The surface of the stone blanket course shall be well drained at all times. The permeability of the aggregate shall be checked per ASTM 2434 (constant head) testing methods. Test samples shall be as described in this specification section.
11. Once the stone blanket is in place, the testing agency shall perform infiltrometer tests on the stone blanket in locations as directed by the Architect. Provide water necessary for tests.
12. All test results will be logged and documented by the Contractor's Onsite Layout Foreman and Geotechnical Engineer for the testing agency. If at any time the stone blanket base does not meet project specifications, it shall be the Contractor's responsibility to restore, at his expense, the stone blanket base to the required grade, cross section, permeability, infiltration and density.
13. After the Contractor has independently confirmed compliance with all the above tolerances (planarity and elevation verified by a licensed surveyor and compaction, gradation, permeability, and infiltration verified by geotechnical engineer), he shall notify the Architect and schedule a final site observation for approval. The Contractor shall make available an orbital laser system and other equipment to the Owner's Inspection Team for the inspection process.
14. Once the stone blanket is approved by the Owner, Architect, Geotechnical Engineer and Turf Installer, install the synthetic turf over the stone blanket as shown on the drawings, approved submittals and as specified. Prior to start of synthetic turf installation, the Turf Manufacturer/Turf Installer of the synthetic turf system shall inspect the stone blanket and supply a letter certifying base acceptance for the purposes of obtaining the Manufacturer's warranty for the synthetic turf playing surface.
15. The Site Contractor is responsible for providing daily onsite supervision of Turf Installer subcontractor at all times to ensure stone blanket planarity, drainage, and compaction is maintained during and after the turf installation.

3.08 FIELD QUALITY CONTROL TESTING AND INSPECTION SERVICES

- A. Soil Testing Service/Geo-Technical Engineer must inspect and approve density tests, retesting, and proof rolling of subgrades, as described in this section, before further construction work is performed thereon.
- B. Perform compaction density testing on compacted fill and imported granular base course in accordance with ASTM D1556, ASTM D1557, ASTM D2922, and D3017.
- C. In place density testing should be performed at a frequency of one (1) test per 500 square feet per lift in smaller open areas, one (1) test per 2,500 square feet per lift in larger open areas, and one (1) test per 25 feet per lift in confined areas and utility trenches.
- D. When the test results indicate that insufficient compaction has been obtained in any layer, the Contractor shall take action to modify or alter the moisture content in the soil, to provide additional compaction and testing or otherwise to increase the in-place soil density. If the Contractor cannot obtain satisfactory compaction due to material properties, the Contractor shall remove the unsatisfactory material and replace with new material at no additional cost to the Owner.
- E. Materials contaminated by mud, debris, organics, frost, and/or other deleterious materials shall be removed and replaced with uncontaminated specified material.
- F. No fill or backfill shall be placed over an area or lift of fill that has not been tested and achieved satisfactory results.
- G. Proof Rolling: On pavement subgrades, in cut areas only, unless otherwise directed by the Architect, the only testing required will be the proof rolling as described below:
 - 1. Provide Soil Testing Service/Geo-Technical Engineer with 48 hour advance notification when subgrades are ready to proof roll.
 - 2. Proof Roll the prepared pavement subgrade surface with fully loaded ten (10 c.y.) cubic yard earth moving truck or, in the opinion of the Architect/Geo-Technical Engineer, using a 5-ton smooth drum roller making at least 3 overlapping passes, in each of 2 perpendicular directions, on static mode at a speed of 1 to 4 feet/second. Check for unstable areas. Subgrades that rut, pump or deflect under the truck's tires may be judged unstable by the Architect/Geo-Technical Engineer. These areas may require further compaction or undercutting as directed by the Soil Testing Service/Geo-Technical Engineer.
- H. Stone Blanket Field Testing:
 - 1. Subgrade: Proof rolling and density testing for subgrade as described in Section 31 22 01.
 - 2. Stone Blanket (for Ball Infields):
 - a. Proof rolling and two (2) density tests as determined by ASTM D698 and measured using nuclear density testing methods.
 - b. Percolation Tests: Notify Architect forty-eight (48) hours in advance and provide water, materials, machinery and labor to carry out testing in presence of Architect. Perform five (5) percolation tests each on each infield stone blanket in areas as directed by the Architect.
 - 3. Stone Blanket (for Synthetic Turf Field):

- a. Proof rolling and ten (10) density tests as determined by ASTM D698 and measured using nuclear density testing methods.
- b. Permeability Test: Perform one (1) permeability test of both installed finishing and base stone as determined by ASTM D2434 confirming permeability rate outlined in "SUBMITTALS" of this specification section.
- c. Infiltrometer Tests: Engage the independent testing agency to perform silt infiltration testing of the in place stone blanket per ASTM D3385-09 using the Double Ring Infiltrometer. Results shall meet the following: Direct infiltration rate of stone blanket system \geq 40"/hour.
 - i. Notify Architect forty-eight (48 hrs.) hours in advance and provide water, materials, machinery and labor to carry out testing in presence of Architect.
 - ii. Perform ten (10) infiltrometer tests each on the installed synthetic turf stone blanket in areas as directed by the Architect.
 - iii. Repair all test areas to match surrounding stone blanket material.

3.09 GUARANTEE

- A. Guarantee concrete slabs, pavements, curbs, trenches, utilities, flagpoles, structures, synthetic turf, track, field events and lawns free from settlement for a period of one (1) year from the date given on the certificate of substantial completion or final punch list when satisfactorily completed and accepted by the Architect, whichever is later.
- B. Repair to proper grade and alignment any and all settlement of concrete slabs, pavements, curbs, trenches, utilities, flagpoles, structures, synthetic turf, track, field events and lawns adversely affected by settlement within one (1) year after date given on the certificate of substantial completion or final punch list when satisfactorily completed and accepted by the Architect, whichever is later, at no additional expense to the Owner. In damaged compacted areas, scarify the surface, re-shape, and compact to required density prior to further construction.
- C. All repairs/corrections shall be completed to the satisfaction of the Owner within seven (7) days of written notice by the Owner.

3.10 CLEAN UP

During the contract and at intervals as directed by the Architect and as earthwork is completed, clear the site of surplus earth, large surface stones, debris, tools and equipment. Leave the site in a clean, safe, well draining, and neat condition.

END OF SECTION

SECTION 31 25 01

EROSION, SEDIMENT AND POLLUTION CONTROL

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Provide erosion, sediment and pollution controls as shown on the drawings and as directed by the Architect to significantly reduce runoff on downstream and neighboring properties. This includes temporary control measures to mitigate land disruption by other Contractors during construction of this project.
- B. Erosion, sediment and pollution control includes, but is not limited to, the following:
 - 1. Storm structure protection
 - 2. Silt fence
 - 3. Off site sediment tracking controls
 - 4. Triangular silt dikes
 - 5. Temporary concrete washout facility
 - 6. Temporary seeding and mulching
 - 7. Permanent seeding and sodding
 - 8. Straw mat
 - 9. Temporary sediment filter bag for pumped water
 - 10. Construction site dust control
 - 11. Spill prevention, reporting and documentation
 - 12. Clean up
- C. Provide materials, labor, equipment and services required to accomplish related work in accordance with the drawings and specifications.
- D. Code Compliance: The New York State Department of Environmental Conservation requires a SPDES General Permit for Storm Water Discharges from Construction Activity. This Permit GP-0-20-001 is pursuant to the Environmental Conservation Law and has penalties and fines related to violations.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 31 12 01 - Site Preparation
- B. Section 31 22 01 - Site Earthwork
- C. Section 32 92 01 - Lawns
- D. Section 33 40 01 - Storm Drainage

1.03 REFERENCES

- A. Spill Guidelines Manual (SGM) New York State Dept. of Environmental Conservation.
- B. New York State Standards and Specifications for Erosion and Sediment Control, dated July 2016 or latest edition.

1.04 SUBMITTALS: (See Section 31 12 01, 1.05)

- A. Manufacturer's Data (MPD) are required for:

1. Storm Structure Protection
 2. Silt Fence with Net Backing
 3. Soil Separation Fabric for Off Site Sediment Tracking Control
 4. Triangular Silt Dikes
 5. Sediment Filter Bag
 6. Straw Mat
 7. Spill Response Equipment
- B. Material Certificates (MC) showing content/mechanical analysis and Samples are required for:
1. No. 3 Stone for Off Site Sediment Tracking Control
 2. Temporary Seeding and Mulching: Submit seed mix species and mulch source
 3. Permanent Seeding & Sodding: (See Section 32 92 01)
- C. Certification Statement: Submit photocopy of Section 31 25 01, 1.07, filled out completely and accurately to the Landscape Architect at the pre-construction meeting.
- D. Listing of emergency contract numbers. This list shall include the name of an Emergency Response Contractor that may be used in certain situations.
- E. Per NYSDEC SPDES Regulations, all onsite contractors performing earth disturbing activities need to have current NYSDEC endorsed 4-hour erosion and sediment (E&SC) training. Provide copies of all onsite personnel certification cards, prior to construction. The document shall be kept on file (by the Contractor) within the onsite SWPPP log book.

1.05 QUALITY ASSURANCE

- A. Perform erosion, sediment and pollution control in compliance with applicable requirements of the New York Standards and Specifications Erosion and Sediment Control Manual, dated July 2016 (or latest edition) or other governing authorities having jurisdiction.
- B. Prevention of erosion and pollution from storm water runoff for the duration of this project is the responsibility of this Contractor. All Storm Water Pollution Prevention control work indicated on the drawings and/or specifications shall be included in this Contractor's Base Bid. Damages resulting from, but not limited to, negligence, improper maintenance or general disregard for erosion control measures shall be immediately corrected by this Contractor to the satisfaction of the Landscape Architect, Engineer, or Certified Erosion Control Specialist hired by the Owner for SWPPP inspections as required by NYSDEC. Damages resulting from other contractors shall be repaired by this Contractor on a time and materials basis and back charged to the responsible party. Any fines levied on the Owner by governing authorities for SWPPP violations shall be back charged to the responsible party.
- C. In the event of a chemical or hazardous spill or release, the individual(s) who caused the spill is responsible for prompt and proper clean-up. If the spill requires cleanup procedures beyond the means of the Contractor, an emergency spill cleanup Subcontractor shall be hired by the Contractor. They shall be utilized when the Contractor does not have the appropriate training, equipment or materials to cleanup the area safely and effectively. This shall be done at no additional cost to the Owner. Any testing and cleanup required post cleanup shall be provided by the Contractor at no additional cost to the Owner.

1.06 JOB CONDITIONS

- A. Job conditions in Sections 31 12 01, 31 22 01, 32 92 01 and 33 40 01 apply.
- B. Contractor will take all necessary precautions to avoid allowing dust generation that violates NYSDEC regulations and compromises compliance with governing authorities air monitoring plan.
- C. Winter Stabilization Requirement: When construction schedule, regardless of reason, prohibits installation of permanent stabilization measures and site elements, including substantial lawn growth to prevent erosion, this Contractor shall install and provide temporary seeding, mulching, and other preventative/stabilization measures specified and as directed by the Landscape Architect at no additional cost to the Owner.

1.07 CERTIFICATIONS

- A. Authorized, legally responsible signatures for the General Contractor, Site Contractor, Site Earthwork, Landscaping Subcontractor(s) and any other soil disturbing Contractor shall sign and prominently display the following certification statement at the job trailer or office during the life of the project:

"I hereby certify under penalty of law that I understand and agree to comply with the terms and conditions of the Storm Water Pollution Prevention Plan (SWPPP) and agree to implement any corrective actions identified by the qualified inspector during a site inspection. I also understand that the owner or operator must comply with the terms and conditions of the most current version of the New York State Pollutant Discharge Elimination System ("SPDES") general permit for storm water discharges from construction activities and that it is unlawful for any person to cause or contribute to a violation of water quality standards. Furthermore, I am aware that there are significant penalties for submitting false information, that I do not believe to be true, including the possibility of fine and imprisonment for knowing violations."

1.	General Contractor	Signature:	_____
		Name:	_____
		Title:	_____
		Address:	_____ _____
		Phone No.:	_____
		Email:	_____
2.	Site Earthwork Contr.	Signature:	_____
		Name:	_____
		Title:	_____
		Address:	_____ _____

Phone No.: _____

Email: _____

3. Site Landscaping Contr. Signature: _____

Name: _____

Title: _____

Address: _____

Phone No.: _____

Email: _____

4. Other Sub Contractors Signature: _____

as determined by the
Architect

Name: _____

Title: _____

Address: _____

Phone No.: _____

Email: _____

1.08 NOTICES

- A. The Operator (Owner) shall file with the New York State Department of Environmental Conservation (NYSDEC) a Notice of Intent (NOI) a minimum of ten (10) days prior to start of construction. Unless notified by the NYSDEC to the contrary within ten (10) days, a general SPDES permit is automatically issued which authorizes discharge of storm water on the construction site.
- B. When the site has been finally stabilized, the Operator (Owner) shall file with the NYSDEC a Notice of Termination (NOT).
- C. The Operator (Owner) is responsible for payment of annual fees related to the SPDES permit. Filing of a NOT shall typically terminate the Operator's fee responsibility.

1.09 INSPECTIONS AND MAINTENANCE

- A. The Architect or qualified personnel of the Operator shall inspect disturbed areas of the construction site at least once per week. Special attention will be focused on areas not finally stabilized, structural control measures, point discharge (outlets) and locations where vehicles enter or exit the site. Disturbed areas will be inspected for pollutants

entering the drainage system. Structural control measures will be reviewed for effectiveness in preventing significant impacts to receiving waters. Locations where vehicles enter or exit the site will be inspected for evidence of off site sediment tracking. A written report of inspections shall be produced in a journal during the construction operations. The journal shall be made available (by the Operator/Owner) for NYSDEC and the general public to review.

- B. The Contractor shall provide timely maintenance of vegetation erosion and sediment control measures, and other protective measures, during construction. Corrective measures must be performed within one (1) calendar day of the Architect's or Operator's (Owner's) report. Failure by the Contractor to perform corrective work within this schedule automatically authorizes the Operator to hire others and backcharge this Contractor. The Architect or Operator will send a letter or email correspondence one (1) calendar day before hiring others and backcharging this Contractor. The Contractor shall keep a written record of maintenance and corrective work in a journal. The journal shall be made available for the Operator, Architect, Landscape Architect, Soil and Water Conservation District, ACOE, and NYSDEC until the site is finally stabilized.
- C. The Contractor shall conduct daily inspections of the equipment staging and maintenance, fueling, hazardous waste staging and waste storage areas to ensure that spill control measures are in place. Stock appropriate clean-up materials whenever changes occur in the types of chemicals used or stored on site.
- D. The Contractor is responsible for having mandatory, up to date NYSDEC endorsed 4-hour erosion and sediment control (E&SC) training all personnel working on site in accordance with the SPDES permit.
- E. The Operator (Owner) shall provide long term maintenance of the storm water facilities after the site is finally stabilized. The designated maintenance personnel shall keep written records and pictures of maintenance and corrective work in a journal. All stormwater discharge points shall be maintained, inspected, and documented. The journal shall be made available for review by the NYSDEC for a minimum period of five (5) years after the Notice of Termination (NOT) has been filed.

1.10 SPILL PREVENTION, REPORTING AND DOCUMENTATION

- A. To minimize the potential for discharge to the environment of oils, petroleum, or other hazardous substances, the following requirements shall apply:
 - 1. All oil, petroleum, or hazardous materials stored or temporarily relocated on site during the construction process shall be stored in a way to provide protection from vehicular damage and to provide containment of leaks or spills. Temporary berms, dikes, storage basins, or similar methods shall be employed as appropriate on site.
 - 2. Refer to Storm Water Pollution Prevention Plan Notes for additional spill prevention good housekeeping practices.
 - 3. Maintain file of Material Safety Data Sheets (MSDSs) or other references for recommended spill clean-up methods and materials.
 - 4. Keep spill response equipment readily accessible.
- B. In the event of a spill contact the Construction Manager, Owner (Operator), and Architect. The Contractor shall also notify all other Contractors working around the area of the spill.

- C. If spilled material has entered any sanitary/storm sewer system then contact the municipality or agency with jurisdiction over the system, in addition to those listed in this section.
- D. The contractor shall be responsible for the initiation of spill reporting and documentation procedures. All petroleum spills must be reported to NYSDEC Spill Hotline at 1-800-457-7362, less than two (2) hours following discovery. All petroleum spills must be reported to NYSDEC unless all of the following apply:

Criteria	Description
Quantity	Must be known to be less than 5 gallons.
Containment	Must be contained on an impervious surface or within an impervious structure. No access to the environment.
Control	Must be under control and not reach a drain or leave the impervious surface.
Cleanup	Must be cleaned-up within two (2) hours of occurrence.
Environment	Must not have already entered into soil or groundwater or onto surface water.

- E. A release of a “reportable quantity”¹ or unknown amount of a hazardous substance must also be immediately reported to the NYSDEC Spill Hotline. Spills of reportable quantities of chemicals or “harmful quantities”² of oil to navigable waters must be reported to the federal National Response Center, 1-800-424-8802 or 1-202-426-2675.

¹ *Reportable Quantity*: Refers to the quantity of a hazardous substance or oil that triggers reporting requirements under the Comprehensive Emergency Response, Compensation, and Liability Act (CERCLA) (USEPA, September 1992).

² *Harmful Quantity*: Includes discharges that violate applicable water quality standards, cause a film, sheen, or discoloration on a water surface or adjoining shoreline; or cause a sludge or emulsion to be deposited beneath the water surface or shoreline (40 CFR 110.3).

PART 2 - PRODUCTS

2.01 STORM STRUCTURE PROTECTION

- A. Shall be a pre-manufactured cylindrical log 12” – 32” in diameter, composed of degradable geotextile mesh tube filled with compost filter media to filter sediment and other pollutants. Filter socks may be filled after placement by blowing compost into the tube pneumatically or filled at a staging location and moved into its designated location. Both ends of the filter socks shall be secured to prevent opening.
- B. The flat dimension of the sock shall be at least 1.5 times the nominal diameter of the sock.
- C. Compost infill shall be a well decomposed (matured at least 3 months), weed-free, organic matter. Shall be aerobically composted, possess no objectionable odors, and contain less than 1% by dry weight, or manmade foreign matter.
- D. All biosolids compost must meet NYS DEC’s 6NYCRR Part 360 (Solid Waste Management Facilities) requirements.
- E. When using compost filter socks adjacent to surface water, the compost should have a low nutrient value.

- F. Wood stakes shall be a minimum of 2" x 2" in size. Shall be untreated fir, redwood, cedar or pine and shall be cut from sound timbers. Shall be straight and free of loose and unsound knots or other defects which would render them as unfit for the intended use. Metal stakes may not be used as an alternate. Tops of stakes shall not extend above the top of the fiber roll.
- G. Standard of quality shall be: Diamond SOCK® pre-filled compost filter sock as manufactured by MKB Stormwater Innovation, 888-578-0777; or Architect Approved Equal

2.02 SILT FENCE

- A. Shall be a woven polypropylene geotextile comprised of UV stabilized polypropylene slit film and 1.25" square, non pressure treated, pointed, hardwood posts and net mesh backing for additional support. Standard of quality for silt fence shall be IVI-3611MW as manufactured by Indian Valley Industries, Inc., www.iviindustries.com, (607) 729-5111, or Architect approved equal.

2.03 OFF SITE SEDIMENT TRACKING CONTROLS

- A. No. 3 stone shall meet the following requirements:

<u>Standard ASTM Sieve Size</u>	<u>Percent Passing by Weight</u>
3"	100
2"	0-15
Passing No. 50	5-10
Passing No. 100	2-5

- B. Soil Stabilization Fabric: Shall be a commercially manufactured, UV stabilized low clogging, high flow, woven geotextile. Standard of quality shall be Mirafi 600X, as manufactured by NICOLON/MIRAFI GROUP, 3500 Parkway Lane, Norcross, Georgia (Tel. 1-800-234-0484) or Architect approved equal.
- C. Granular Base Course Material: Shall be as specified in Section 31 22 01.

2.04 TRIANGULAR SILT DIKES

- A. Silt dikes shall be triangular-shaped, having a height of at least eight to ten inches (8" - 10") in the center with equal side and a sixteen to twenty inch (16" - 20") base. The triangular-shaped inner material shall be urethane foam. The outer cover shall be woven geotextile fabric placed around the inner material and allowed to extend beyond both sides of the triangle two to three (2' - 3') feet. Standard length of each dike will be seven feet (7') unless otherwise indicated on the plans. The dikes shall be attached to the ground with wire staples.
- B. Wire staples shall be No. 11 gauge wire and be at least six to eight (6" - 8") inches long. Staples shall be placed as indicated on the installation detail.
- C. Standard of Quality shall be Triangular Silt Dike as manufactured by Triangular Silt Dike, Inc., 608 Greenwood Drive, Midwest City, OK 73110, (800) 290-8473.

2.05 TEMPORARY SEDIMENT FILTER BAG FOR PUMPED WATER

- A. Provide prefabricated bags/pouches with nonwoven geotextile fabric. The standard of quality shall be Dirtbag as manufactured by ACF Environmental, 800-448-3636 or Architect approved equal.
- B. Provide wooden pallet to set filter bag on for ease of disposal.

2.06 TEMPORARY CONCRETE WASHOUT FACILITY

- A. Concrete washout facility to fully contain all concrete washout needs of the entire project and all contracts.
- B. Concrete washout facility shall be temporary straw bales that are lined with a single sheet of a minimum of 10 mil polyethylene sheeting that extends over the entire basin to prevent escape of discharge. Place a secure, non-collapsing, non-water collecting cover over the concrete washout facility prior to inclement weather to prevent accumulation and overflow of precipitation.
- C. Provide concrete washout to prevent discharge from concrete trucks or equipment cleaning to inlets, surface or groundwater.
- D. Concrete washout facility shall be no closer than 50 feet from environmentally sensitive areas such as waterbodies, wetlands, and open drainage facilities and watercourses. Signs shall designate concrete washout facilities.
- E. Ensure that the concrete washout facility complies with all Federal, State and local laws, rules, and regulations. Ensure that the concrete washout facility is in place before delivery of concrete to site.
- F. Provide a sign identifying area as "Concrete Washout" acceptable to the Architect. Maintain throughout the project duration.

2.07 TEMPORARY SEEDING AND MULCHING

- A. Seeding shall be 100% Perennial Ryegrass with no more than 30% of any one cultivar and always at least 2 different cultivars and a 90% germination rate or more.
- B. All seed mixtures to contain 0.5% weed seed or less.
- C. All seed must be fresh seed, not seed that is left over from last year and beyond the sell by date.
- D. Dry mulch shall be clean straw bales.

2.08 PERMANENT SEEDING AND SODDING

Seeding and Sodding shall be as specified in Section 32 92 01.

2.09 STRAW MAT

- A. 100% biodegradable thread on 1.5 inch centers stitched to a 100% biodegradable natural fiber top net. Blanket shall be manufactured with a colored line or thread stitched 2-5 inches from edge to ensure proper overlap. Standard width is 4'-0".
- B. Standard of quality shall be BioNet Blanket as manufactured by North American Green, 1-800-772-2040 or Architect approved equal for the following slope conditions:

<u>Slope Condition</u>	<u>Water Flow Condition</u>	<u>Product Type</u>
4:1 (or flatter)	Low flow (5 fps)	S75BN: Single Net Straw
3:1	Moderate flow (6 fps)	S150BN: Double Net Straw
2:1	Medium flow (8 fps)	SC150BN: Double Net Straw-Coconut (70/30 blend)
1:1 (and greater)	High Flow (10 fps)	C125BN: Double Net Coconut

- C. Stakes: Six inch lengths of 100% biodegradable "T" shaped pin designed to safely secure erosion control blanket. Standard of quality shall be Bio-Stake as manufactured by North American Green or Architect approved equal.

2.10 SPILL RESPONSE EQUIPMENT

- A. The following is a list of recommended spill control material. The contractor is responsible to have spill control and personnel protective equipment readily available for the materials being used. Acquire sufficient quantities and types of appropriate spill control materials needed to contain any spills that can be reasonably anticipated. The need for equipment to disperse, collect and contain spill control materials should be on site at all times.

1. Personal Protective Equipment
 - a. Chemical Splash Goggles
 - b. Gloves
 - c. Boot Covers
 - d. Tyvek Aprons or Suits
2. Absorption Materials
 - a. Spill Pillows and Socks
 - b. Absorbent Booms and Pads
 - c. Dikes for use on rough surfaces
 - d. Storm Structure Covers
 - e. "Loose" Absorbents
3. Tools
 - a. Shovel, Broom, Brush
 - b. Disposal Bags
 - c. Sealing Tape
 - d. Hazardous Waste Stickers
 - e. "Danger" and "Keep Away" Signs
 - f. Five gallon pails or 20 gallon drums with polyethylene liners

- B. Basis of Design shall be provided by: 3M, 888-364-3577; New Pig Corporation, 800-468-4647; SpillKits911, 800-474-5911; Dawg, Inc., 800-935-3294; or Architect approved equal.

- C. Place spill response equipment in a readily assessable location within or immediately adjacent to the project site.

PART 3 - EXECUTION

3.01 SIGNATURE REQUIREMENTS

- A. Between the Pre-Construction Meeting and starting site work, the Contractor shall:

1. Sign the certification statements. Contractor shall prominently display the statements at the job site.
2. Review inspection and maintenance procedures. Decide where journals will be temporarily stored for review by NYSDEC, S&WC, ACOE, Operator (Owner), the Landscape Architect and Architect.
3. Designate specific Owner and Contractor personnel responsible for daily inspection and maintenance. Provide certification cards.

3.02 GENERAL EROSION CONTROL

- A. Install initial construction erosion control features, as indicated on drawings and specifications or as directed by the Architect, prior to topsoil stripping, earthwork, and removal of existing vegetation. Keep the disturbance to a minimum and shall not exceed five (5) acres, unless directed by the Architect. Install other features as described in the sequence of erosion, sediment and pollution control on the drawings.
- B. Start permanent seeding and mulching within seven (7) calendar days of rough grading. When this is not possible for any reason, provide temporary seeding on non-roof, non-paved areas with 100% perennial rye grass at the rate of six pounds (6#) seed per one thousand (1,000 sf) square feet and straw mulching for complete coverage. When adverse weather conditions prevent good germination, repeat seeding and mulching as directed by the Architect until the area is stabilized. Till under temporary grass and fine grade when preparing for final permanent lawn stabilization.
- C. Until a disturbed area is stabilized, trap runoff sediment by the use of sediment debris basins, diversion swales, sediment traps, or other methods acceptable to the Architect and governing authorities. Provide temporary dry mulch (straw) to stabilize exposed soils as directed by the Architect.
- D. Provide erosion controls on slopes and swales traversing, bordering, or leaving the site. Limit the water flow to a nonerosive velocity.
- E. Do not store fill materials within one hundred (100') feet of the banks of any streams or waterbodies, intermittent or perennial.
- F. Inspect erosion and sediment control measures immediately after each rainfall and at least daily during prolonged rainfall. Make required repairs immediately.
- G. Remove sediment deposits when they reach approximately one-half of the height of the barrier. Dispose sediment in a manner that does not result in additional erosion or pollution.
- H. Provide prompt (weekly) removal and disposal of rubbish and debris in accordance with the governing authorities, Owner policies, and good housekeeping measures.
- I. Traffic shall not be permitted to cross filter socks.

3.03 MUNICIPAL SEWER, SWALES AND WETLAND EROSION CONTROL

Control erosion, siltation and pollution to municipal sewers, swales and wetlands by taking appropriate measures such as, but not limited to, the following:

- A. Do not disturb the bed and banks of waterbodies unless specifically shown on drawings. When bed and bank work is shown, obtain permits and proceed with work creating the minimum disturbance necessary to complete the project.

- B. Prevent petroleum products and excessive amounts of silt, clay, and muck from entering municipal sewers, waters, swales or wetlands of New York State during construction.
- C. Prevent fresh concrete, concrete leachate, and washings from equipment and trucks, from entering municipal sewers, waters, swales or wetlands of New York State during construction.
- D. Place silt fence to control erosion at the downslope edge of disturbed areas. This barrier to sediments is to be put in place before disturbance of the ground occurs and is to be maintained in good condition until disturbed land is heavily vegetated or otherwise permanently stabilized.
- E. Seed areas of soil disturbance resulting from this project with appropriate perennial grass seed and mulched with straw within seven (7) calendar days as described in general erosion control. Mulch shall be maintained until a suitable vegetative ground cover is established and as directed by the Architect.

3.04 CONSTRUCTION SITE DUST CONTROL

- A. The Contractor shall prevent surface and air movement of dust from disturbed soil surfaces that may cause off-site damage, health hazards, and traffic safety issues.
- B. Dust control applies to construction roads, access points, other disturbed areas and stockpiles subject to surface dust movement and dust blowing.
- C. Contractor may use any number and combination of dust control methods, as approved by the Architect. They include:
 - 1. Applying water to haul roads
 - 2. Restricting vehicle speeds to 10 mph
 - 3. Hauling materials in properly tarped or watertight containers.
 - 4. Covering stockpiles and materials
 - 5. Wetting equipment and work area
 - 6. Mulching
 - 7. Spray adhesives and polymer additives (MSDS sheets required)
 - 8. Barriers and wind breaks
- D. Contractor is responsible for any cleanup and site restoration associated with dust control measures, dust pollution on or off the project site property at no additional cost to the Owner.

3.05 STORM STRUCTURE PROTECTION

- A. Install fiber rolls as detailed around drainage structures and where shown on the plans to protect site elements from silt and sediment.
- B. Filter socks shall be anchored in earth with wooden stakes driven a minimum of 12" into the soil on 4-foot centers on the centerline of the sock. On uneven terrain, effective ground contact can be enhanced by the placement of a fillet of filter media on the disturbed area side of the compost sock.
- C. Wrapping the storm structure grate with fabric is NOT acceptable, however straw bales may be used.

- D. Upon stabilization of the area contributory to the sock, stakes shall be removed. The sock may be left in place and vegetated or removed in accordance with the SWPPP. For removal, the mesh can be cut, and the compost spread as an additional mulch to act as a soil supplement.

3.06 SILT FENCE

- A. Locate as shown on drawings and as directed by the Architect. Excavate trench along the lower perimeter(s) of site, along the contract limit line, and as indicated on the drawings. Place excavated material on uphill side of trench for backfilling.
- B. Drive stakes securely into the downhill side of the trench. When prefabricated silt fence with fabric attached to stakes is used, drive stakes so that fabric is buried in the ground as detailed.
- C. Backfill trench with excavated material, so that fabric is securely buried in the ground to prevent undermining. Tamp soil.
- D. Join sections by overlapping fabric between two (2) stakes. Set stakes simultaneously. Overlap by minimum six (6") inches, fold, and staple to prevent sediment bypass.
- E. Attach silt fence securely to stakes spaced no more than eight (8' o.c.) feet on center. Secure fence fabric to stake with minimum three one (1") inch staples.
- F. Toward the end of the project, when site is stabilized and as directed by the Architect, remove silt fence and correct lawn area around removal to a smooth, neat, well-draining condition.

3.07 OFFSITE SEDIMENT TRACKING CONTROLS

- A. Install as detailed and shown on drawings to eliminate tracking sediment off site. Inspect after each rain storm and at the end of each work day.
- B. When sediment begins tracking off site, sweep and clean affected roadway immediately and replace stone with clean No. 3 stone to retain sediment on site.
- C. Remove fabric and stone at project completion. Complete construction of proposed final surface(s).

3.08 TRIANGULAR SILT DIKES

Install as detailed and as recommended by the manufacturer.

3.09 TEMPORARY SEDIMENT FILTER BAG FOR PUMPED WATER

- A. Install prefabricated bags/pouches on top of straw bale base as recommended by the manufacturer. Replace system when full (discharge into bag/pouch is significantly reduced).
- B. Silt may be used as general site fill or hauled off site. Remove straw bales, fabric, and prefabricated bags/pouches off site. Regrade area and return to lawn as specified.

3.10 TEMPORARY CONCRETE WASHOUT FACILITY

- A. Install per detail in a location as approved by the Owner. Provide a stable surface, easily accessible by concrete trucks.
- B. A sign shall be installed adjacent to each washout facility to inform concrete equipment operations to utilize the proper facilities. The sign shall be installed as detailed and maintained throughout the project.
- C. Temporary concrete washout facility shall be constructed and maintained in sufficient quantity and size to contain all liquids and concrete waste generated by washout operations for the entire project and by all Contracts.
- D. Perform washout of concrete mixers, delivery trucks, and other delivery systems in designated areas only.
- E. Wash concrete only from mixer chutes into approved concrete washout facility.
- F. Plastic lining material shall be a minimum of 10-mil polyethylene sheeting and shall be free of holes, tears or other defects that compromise the impermeability of the material. Liner seams shall be installed in accordance with manufacturers' recommendations.
- G. Contents of the concrete washout facility shall not exceed 50% capacity of the facility. At or before 50% capacity is reached, discontinue pouring concrete until the facility is cleaned out. Remove hardened concrete and properly dispose off site. Allow slurry to evaporate or remove from site and dispose off site. Immediately replace the liner if it gets damaged.
- H. Remove concrete washout facility when it is no longer needed as directed by the Architect.

3.11 TEMPORARY SEEDING AND MULCHING

- A. Provide temporary seeding of topsoil stockpile immediately.
- B. When necessary and as directed by the Architect, provide temporary seeding and mulching on disturbed areas at no additional cost to the Owner.

3.12 PERMANENT SEEDING AND SODDING

- A. Install as described in Section 32 92 01.

3.13 STRAW MAT

- A. Install as recommended by the manufacturer and as directed by the Architect for drainage channels and slopes.
- B. Stake spacing shall reflect slope to which the straw is being applied.

3.14 SPILL RESPONSE EQUIPMENT

Use per manufacturer's recommendations and as directed by the NYSDEC, or other governing agencies.

3.15 CLEAN UP

- A. During the contract and at intervals as directed by the Architect and as erosion, sediment and pollution control procedures are completed, clear the site of extraneous materials, rubbish, and debris. Leave the site in a clean, safe, well draining, and neat condition.
- B. Clean storm ponding areas, catch basins and detention basins: Clean out contaminants, sediment, rubbish, construction debris, foreign objects and accumulated floatables from chambers and ponding areas thoroughly, immediately prior to final acceptance.

END OF SECTION

SECTION 32 12 01

ASPHALT PAVING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. The extent of asphalt paving is shown on the drawings.
- B. Asphalt Paving work includes, but is not limited to, the following:
 - 1. Soil Stabilization Fabric
 - 2. Granular Base Course
 - 3. Asphaltic Concrete
 - 4. Bituminous Tack Coat
 - 5. Double Bituminous Treatment Pavement
 - 6. Painted Lines and Traffic Markings
 - 7. Hot Pour Crack Sealing and Filling
 - 8. Field Quality Control
 - 9. Clean up
- C. Provide all materials, labor, equipment and services required to accomplish related work in accordance with the drawings and specifications.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 31 12 01 - Site Preparation (Asphalt Milling)
- B. Section 31 22 01 - Site Earthwork
- C. Section 33 40 01 - Storm Drainage

1.03 REFERENCES

- A. The latest editions of the following Standards, as referenced herein, shall be applicable:
 - 1. New York State Department of Transportation Standard Specifications, Section 402 - "Hot Mix Asphalt (HMA) Pavements" and 407 - "Bituminous Tack Coat"
 - 2. "Standard Specifications for Highway Materials and Methods of Sampling and Testing, American Association of State Highway and Transportation Officials (AASHTO)."
 - 3. American Sports Builders Association (ASBA) Asphalt Guidelines, latest edition
- B. The following reference standards shall apply for Testing and Inspection:
 - 1. ASTM D1074: Standard Test Method for Compressive Strength of Bituminous Mixtures
 - 2. ASTM D1188: Standard Test Method for Bulk Specific Gravity and Density of Compacted Mixtures Using Paraffin-Coated Specimens.
 - 3. ASTM D2041: Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
 - 4. ASTM D2726: Standard Test Method for Bulk Specific Gravity and Density of Non-absorptive Compacted Bituminous Mixtures
 - 5. ASTM D2950: Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods

6. ASTM D3203: Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures
 7. ASTM D3549: Standard Test Methods for Thickness or Height of Compacted Bituminous Paving Mixture Specimens
 8. NYSDOT Materials Method 28 Friction Aggregate Control and Test Procedures
- C. The following reference standards shall apply for pavement markings:
1. ASTM D562, D711, D1475, D1640, D2369, D3723, D3960.
 2. DOT Code of Federal Regulations, Hazardous Materials and Regulations Board, Reference 49CFR, ICC Regulations
 3. Federal Specification TT-P-115E, Type III (Type I if V.O.C. compliance)
- D. Additional testing required, only if directed in writing by Architect, due to asphalt installation and material issues:
1. ASTM C295: Standard Guide for Petrographic Examination of Aggregate
 2. ASTM D1560: Standard Test Methods for Resistance to Deformation and Cohesion of Bituminous Mixtures by Means of Hveem Apparatus
 3. ASTM D4125: Standard Test Methods for Asphalt Content of Bituminous Mixtures by the Nuclear Method
 4. ASTM D5444: Standard Test Method for Mechanical Size Analysis of Extracted Aggregate
 5. ASTM D6307: Standard Test Method for Asphalt Content of Hot-Mix Asphalt by Ignition Method
 6. ASTM D6931: Standard Test Method for Indirect Tensile (IDT) Strength of Asphalt Mixtures
 7. ASTM D7312: Standard Test Method for Determining the Pavement Shear Strain and Complex Shear Modulus of Asphalt Mixtures Using the Superpave Shear Tester

1.04 SUBMITTALS

- A. Provide Paving Contractor experience requirements, as outlined in "Quality Assurance" of this specification section, for the following:
1. General Paving
 2. Running Track/Field Events
- B. Provide Asphalt Producer Vendor Certificate and proof of quality control monitoring as outlined in "Quality Assurance" of this specification section.
- C. Provide material certificates showing content/mechanical analysis for the following:
1. Asphaltic Concrete Mix Design with Authorization Signature:
 - a. Type/name of mix (less than 24 months old)
 - b. All aggregates gradations and quality measurements
 - c. Plot (0.45 power graph) of the final aggregate blend
 - d. Bulk (dry) specific gravity of all aggregates and final aggregate blend (Gsb) including worksheets for natural (virgin) as well as reclaimed asphalt pavement (RAP)
 - e. Grade of asphalt binder (PG) being used
 - f. Optimum percent asphalt binder (Pb)
 - g. Mix air voids at optimum (Va)
 - h. Bulk specific gravity of mix at optimum (Gmb)

- i. Theoretical maximum specific gravity of mix at optimum
 - j. Voids in the Mineral Aggregate (VMA) and Void Filled with Asphalt (VFA)
 - k. Dust to total asphalt content (AC) ratio
 - l. All design data and associated design curves
 - 2. Bituminous Tack Coat
 - 3. Double Bituminous Treatment Pavement
- D. Provide Manufacturer's Product Data (MPD) for the following:
 - 1. Soil Stabilization Fabric
 - 2. Painted Lines and Traffic Markings
 - 3. Hot Pour Crack Sealing and Filling
- E. Provide shop drawings for the following:
 - 1. Painted Lines and Traffic Markings: Shop drawings indicating sizes, shapes, patterns, and colors of markings, including manufacturers and types of paint.
 - 2. Owner to approve all paint colors prior to installation.
- F. Submit Asphalt Placement Work Plan, indicating: paving pass widths, paving directions, site access, and timing/coordination of any site equipment installation (posts, boxes, fencing, etc.) indicated in 3.03 of this specification section. Supply Owner with yield calculations for all asphalt paving products and materials used on the project as part of the work plan.
- G. Field Quality Control test reports as indicated in this specification section.
- H. As-built survey required for running track and field events, prior to athletic surfacing installation.

1.05 QUALITY ASSURANCE

- A. Paving Contractor Experience Requirements:
 - 1. General Paving: Contractor shall have the experience of at least five (5) years in business. Paving superintendent has a minimum of three (3) years' experience as a paving crew operating foreman.
 - 2. Running Track and Field Event Asphalt: Contractor shall have the experience of at least five (5) similar installations within the past three (3) years. These installations shall be in locations, size and operating conditions similar to those for this project. Employ only thoroughly trained personnel, experienced and familiar with running track and field event paving and the tolerances required by the governing body. Provide project references including dates, project contacts, and approximate project cost.
- B. Asphalt Testing and Inspection Services:
 - 1. The Owner will employ and pay for the services of an Independent Testing Agency to provide testing and inspections of asphalt pavements.
 - 2. The services and the information provided by the Testing Agency are provided for the sole benefit of the Owner. The information is provided to the Contractor for the sole purpose of being aware of what is being reported.

3. The Contractor is solely responsible for assuring the work complies with the Contract Documents in all respects and may not rely on the testing agency for this or any other assurances. The Testing Agency and their representatives are not authorized to revoke, alter, relax, enlarge, or release any of the requirements of the Contract Documents, approve or accept any portion of the work, perform or excuse any duties of the Contractor, or be involved in the scheduling of any work.
 4. Asphalt paving materials and operations shall be tested and inspected as the work progresses. Failure by the Testing Agency to detect any defective work or material shall not in any way prevent later rejection (when such defect is discovered) nor shall it obligate the Owner for final acceptance.
- C. Asphalt producer shall monitor production according to the procedures of NYSDOT Material Method 28 Friction Aggregate Control and Test Procedures. Asphalt producer shall be a New York State approved/certified HMA (Hot Mix Asphalt) manufacturing facility.
 - D. Calibrated equipment and qualified personnel must be always accessible during the construction of the HMA.

1.06 JOB CONDITIONS

- A. Job conditions in Section 31 22 01 apply.
- B. Atmospheric conditions for applying courses:
 1. Hot mix asphalt shall generally arrive on the project site between 270°-300° F. (per asphalt producer recommendations).
 2. Place asphalt concrete wearing course or bituminous surface treatment only when atmospheric temperature is above 50 degrees F. and rising, and when asphalt binder course is thoroughly dry.
 3. Place binder course only when air temperature is above 45 degrees F. and rising and when asphalt base course or granular stone base course is thoroughly dry.
- C. Grade Control: Establish and maintain required lines and elevations.
- D. Codes and Standards: Perform the work in compliance with applicable requirements of governing authorities having jurisdiction. Obtain and pay for permits required by local authorities.
- E. Construction Review and Testing: Notify and coordinate with the Independent Testing Agency and Architect when the subgrade is shaped and ready for proof rolling. Also, when the granular base course is fully installed, compacted and ready for density testing. Protect subgrade and subbase at all times.
- F. When staging or scheduling delays occur and wearing course cannot be installed directly after binder course installation before winter, provide temporary asphalt transition ramp/collar around drainage structures in paved areas and at handicap ramps to prevent damage by snow plow. Remove prior to installation of wearing course. Power wash surface and apply asphalt tack coat, as specified, prior to wearing course installation, at no additional cost to the Owner.

1.07 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver all materials to the job site with all labels intact and legible at time of installation.
- B. Store materials off ground under cover. Protect from damage or deterioration.
- C. Handle materials to prevent damage to surface, edges, ends and factory applied finishes of items. Damaged material shall be rejected and replaced.

PART 2 - PRODUCTS

2.01 SOIL STABILIZATION FABRIC

- A. Shall be a heavy duty, commercially manufactured woven polypropylene geotextile. Standard of quality shall be Mirafi 500X, manufactured by TenCate or Architect approved equal.

2.02 GRANULAR BASE COURSE

- A. Shall be as specified in Section 31 22 01.
- B. The graded and designed granular base below all new Asphaltic Concrete Pavements shall be constructed, tested, and prepared in accordance with Section 31 22 01 - Site Earthwork of the Contract Documents.

2.03 ASPHALTIC CONCRETE

A.	<u>Pavement Types</u>	<u>Percent Asphalt*</u>
	37.5mm Type 1 Base Course	4.8% Asphalt
	19.0mm Type 3 Binder Course	4.8% Asphalt
	9.5mm Type 7 Top Course	6.3% Asphalt

* Percentage of Asphalt is approximate and shall be based off actual project submittals provided by the Asphalt Producer.

- B. Hot Mix Asphalt Top Course: Pavement shall meet the minimum requirements for 9.5 mm (Type 7) SUPERPAVE Hot Mix Asphalt Top Course (75 gyrations), with a PG 64-22 Binder as specified in Section 402, of the current NYSDOT Standard Specifications, with the exception that the maximum proportion of Recycled Asphalt Pavement (RAP) to virgin aggregates shall not exceed 15% of the total mix.
- C. Hot Mix Asphalt Binder Course: Pavement shall meet the minimum requirements of 19.0mm SUPERPAVE Hot Mix Asphalt Binder Course (75 gyrations), with a PG 64-22 Binder, as specified in Section 402, of the current NYSDOT Standard Specifications, with the exception that the maximum proportion of Recycled Asphalt Pavement (RAP) to virgin aggregates shall not exceed 20% of the total mix.
- D. Hot Mix Asphalt Base Course: Pavement shall meet the minimum requirements of 37.5mm SUPERPAVE Hot Mix Asphalt Base Course (75 gyrations), with a PG 64-22 Binder, as specified in Section 402, of the current NYSDOT Standard Specifications, with the exception that the maximum proportion of Recycled Asphalt Pavement (RAP) to virgin aggregates shall not exceed 20% of the total mix.

- E. The coarse aggregate used in HMA shall be sound, angular crushed stone or crushed gravel. The fine aggregate shall be well graded, moderately sharp to sharp (angular) sands.

2.04 BITUMINOUS TACK COAT

- A. Material shall consist of an asphalt emulsion, Grade RS-1h, and shall meet the minimum requirements of Section 407, of the current NYSDOT Standard Specifications. Bituminous Tack Coat shall be installed over all new and existing concrete and asphalt pavements and structures prior to the installation of new Hot Mix Asphalt materials. The following application rates shall apply:

1.	New Hot Mix Asphalt	0.05-0.07 gal/sy
2.	Milled Surfaces of Existing Asphalt	0.10-0.15 gal/sy
3.	Abutting Vertical Edges (drainage structures, appurtenances)	0.05-0.07 gal/sy
4.	All Styles of Curbs and Gutters	0.05-0.07 gal/sy
5.	Delayed asphalt installation of HMA Courses	0.10-0.15 gal/sy

2.05 DOUBLE BITUMINOUS SURFACE TREATMENT

- A. Shall conform to NYSDOT Standard Specifications, latest edition, Section 410 except two courses are required.
- B. Stone Aggregate: For double surface treatment shall meet NYSDOT item 703-4 specification. First course shall be No. 1 stone, second course 1A stone.
- C. Asphalt Emulsion: For double surface treatment, shall meet NYSDOT item 702-3201, MS-2 medium setting. This may be modified, by agreement with the Architect, for weather conditions.

2.06 PAINTED LINES AND TRAFFIC MARKINGS

- A. The extent of the pavement markings shall match the extent, location and composition of pavement markings existing at the site prior to start of work where applicable.
- B. The work includes, but is not limited to the following: parking stall divider lines, wheelchair legends, "STOP" legends, "NO PARKING" legends, pick-up zone, striping and legends, directional arrow legends, diagonal striping, center line striping, fire lane striping, student area line striping, and other pavement markings as may be shown on the plans.

All templates utilized for road/traffic markings and painted lines shall be turned over to the Owner at the end of the project, in a location as noted by the Owner.

- C. Provide ready-mixed, one component waterborne traffic line paint. Standard of quality shall be: Pro-Park® Waterborne Traffic Marking Paint B-97 Series as distributed through Sherwin-Williams, 800-474-3794; or Architect approved equal.

- 1. Colors (as approved by the Owner in writing):
 - a. Yellow: 1 Gallon & 5 Gallon, Product Number B97YD2467
 - b. White: 1 Gallon & 5 Gallon, Product Number B97WD2434
 - c. Blue: 1 Gallon & 5 Gallon, Product Number B97LD2022
 - d. Black: 1 Gallon & 5 Gallon, Product Number B97BD2021

2. Paints shall contain all necessary co-solvents, dispersants, wetting agents, preservatives and all other additives, so that paint shall retain viscosity. Halogenated solvents and glass beads shall not be permitted.
3. Volatile Organic Compound (VOC) content shall not exceed 250 grams maximum per liter of paint as determined in accordance with ASTM D 3960 test, excluding water and exempt solvents.

2.07 HOT POUR CRACK SEALING AND FILLING

- A. Single component, hot applied asphalt crack and joint sealant capable of withstanding temperatures of up to 450° without experiencing polymer degradation.
- B. Shall be supplied in solid blocks comprised of heat stabilized polymers and asphalt.
- C. Meeting the following material requirements when tested in accordance with ASTM D5329. (see chart below)

Chemical & Physical Analysis

Recommended Application Temperature	350-400°F
Maximum Heating Temperature	450°F
Cone Penetration at 25°C	50 max.
Flow at 60°C, mm	0.
Softening point	200°F Min.
Flexibility 0°F	(1" Mandrel)-Pass
Specific Gravity	1.17
Asphalt Compatibility	Passes

- D. Standard or quality shall be Crack Master Supreme as manufactured by Thorworks Industries, Inc., 800-395-7325, www.thorworks.com or approved equal.

PART 3 - EXECUTION

3.01 PREPARE SURFACE

- A. Prior to commencement of asphalt paving, all excavations, drainage, utilities, backfilling, fencing, bollards, storm structures, curbing installations, adjustments, proof-rolling and density test procedures shall be complete to the satisfaction of the Architect.
- B. Prior to commencement of tack coat and asphalt paving within pavement milled areas, as shown on the plans, all cracks and joints in the milled pavement surface shall be prepared and filled in accordance with the project specifications. Any oil or grease spots shall be scraped and treated to prevent bleeding through the tack coat.
- C. Saw cut, using straight and true lines, all existing asphalt pavements to remain in place with straight, neat edge for abutting against proposed asphalt pavement.
- D. Provide and confirm field quality control as described in Section 31 22 01 for pavement subgrade and granular base course stone.

3.02 CONSTRUCT PAVEMENT GRANULAR BASE COURSE

- A. General: Consists of placing granular base course material, in layers of specified thickness, over prepared subgrade and fabric to support a pavement course.

- B. Grade Control: Provide engineering layout per Section 31 22 01 and grade stakes. During construction, protect grade stakes; maintain lines and grades including crown and cross-slope of each course.
- C. Install soil stabilization fabric after subgrade has been acceptably compacted and proof rolled. Install soil stabilization fabric as recommended by the manufacturer AND;
 - 1. Lay fabric in direction of construction traffic.
 - 2. Overlap fabric side to side and end to end a minimum of two (2') feet.
 - 3. Establish reasonable compaction and rut stability before using heavy or vibratory compaction equipment.
- D. Placing:
 - 1. Place granular base material over soil stabilization fabric, on prepared subgrade in layers of uniform thickness, conforming to the asphalt pavement details on the drawings.
 - 2. Place granular base material in a maximum of six (6) inch layers and compact with a vibratory or 10 ton smooth wheeled roller.
- E. Provide density testing as described in Section 31 22 01.
- F. Surface Smoothness: Test finished surface for smoothness. Surface will not be acceptable when it deviates more than 3/8" measured by a 10 foot straightedge, in any direction.
- G. The finished grade of the granular base course shall be verified to ensure that the final finished product of the bituminous concrete pavement surface will be installed to the lines and grades of the existing pavements and proposed elevations surveyed by the Contractor prior to the start of the paving work.

3.03 PLACE ASPHALT MIX

- A. General:
 - 1. The Contractor shall submit a paving plan, indicating intended direction of paving, number of pulls, etc. for approval prior to the start of paving operations.
 - 2. Joints: Saw cut vertical straight, neat edges for joints required. Joints shall be sharp and clean, conforming to shapes drawn on drawings. Ragged joints will not be accepted.
 - 3. Mill two (2') feet into surface of adjacent asphalt so joints do not line up or "stack".
 - 4. Place bituminous tack coat to all surfaces as indicated in this specification. When pavement surface temperature is above or below the 75-130 degrees F. range, the grade of asphalt emulsion must be modified according to NYSDOT standards. Tack coat shall not be applied to a wet surface or when the pavement surface temperature is below 45 degrees F.
 - 5. Place asphalt on approved prepared surface, spread and strike-off.

6. Spread mixture at minimum temperature of 225-240 degrees F. Place inaccessible and small areas by hand. Hand work shall be minimized to ensure the best possible finished surface.
 7. Place each course to required grade, cross-section, and compacted thickness.
 8. Paving operations shall not be scheduled when ample time does not exist to place, compact, and finish roll the hot mix asphalt during daylight hours and prior to rainfall.
- B. Pavement Placing: Shall be installed in accordance with Section 402-“Hot Mix Asphalt (HMA) Pavements”, of the current NYSDOT Standard Specifications.
- C. Paving Equipment:
1. Must be capable of placing, spreading and finishing courses of HMA to the specified thickness.
 2. HMA shall be free of marks, segregation and be placed to the required uniform elevation with a smooth texture not showing tearing, shoving, or gouging.
 3. Auger extensions are required while pavers are extended beyond the basic screed width.
 4. Paving equipment shall be self-propelled and capable of maintaining the line and grade shown on the plans with suitable electronic equipment. The screed shall be straight and true with no bow and utilizing a vibratory screed. Paving equipment should have fully functional screed heaters and joint preheaters.
- D. Asphaltic Concrete shall be installed as follows:
1. Medium Duty Asphalt Pavement: Installed in two (2) lifts consisting of 19.0mm SUPERPAVE Hot Mix Asphalt Binder Course overlain by 9.5mm SUPERPAVE Hot Mix Asphalt Top Course.
 2. Heavy Duty Asphalt Pavement: Installed in three (3) lifts consisting of a 37.5mm SUPERPAVE Hot Mix Asphalt Base Course overlain by 19.0mm SUPERPAVE Hot Mix Asphalt Binder Course overlain by 9.5mm SUPERPAVE Hot Mix Asphalt Top.
- E. Place in strips not less than ten (10') feet wide, unless otherwise acceptable. In placing each succeeding pass after the placement of the initial pass, the screed of the paver shall be set such that it overlaps the preceding pass by 6" and be sufficiently high such that when compacted, a smooth joint is produced. Prior to pinching the joint, the excess material shall be pushed onto the edge of the new pass with a lute. Excess material shall be removed.
- F. After first lift has been placed and rolled, place succeeding lifts and extend rolling to overlap previous lifts. Where possible, top course shall be placed at right angles to binder course and in the direction that the drainage flows. Where this is impractical, offset joints of the two courses by a minimum of two (2') feet so upper and lower joints do not align.
- G. For pavement placing on the running track and field events: the paver shall be equipped with and utilize both automatic (laser controlled) grade and slope control to maintain required tolerances. Pavement of running track oval passes shall be continuous. Paving

equipment shall be equipped with sonar pods or no contact skis for athletic asphalt construction.

3.04 ROLL ASPHALT MIX

A. General:

1. Rollers shall conform to the manufacturer's specifications for all ballasting. At least one vibratory roller shall be required for each project, with two rollers required as a minimum. (Three rollers shall be required when tonnage is greater than 300 tons/day.)
2. Rollers shall be of a good condition and capable of compacting the HMA to the minimum in-place density required by this specification. Compact asphalt with a nominal 10 ton steel wheel roller or pneumatic rubber tired roller. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.
3. Begin rolling when mixture will bear roller weight without obvious or excessive displacement.

B. Finish Rolling: Each lift of the Asphaltic Concrete Pavement shall be mechanically rolled and compacted to the finished thicknesses specified in the Contract Documents. The pavements shall be compacted to a minimum of 94%-97% (95%-102% at longitudinal joints) of the materials theoretical density as determined by AASHTO Method T 209 and an air void percentage of 5%-6% maximum.

C. Patching: Remove and replace paving areas mixed with foreign materials, dirt, and defective areas. Cut-out such areas and fill with fresh, hot asphalt concrete. Compact by rolling to maximum surface density and smoothness.

D. Joints:

1. The Contractor shall sequence the installation and orientation of all Asphaltic Concrete Pavements such that the minimum numbers of longitudinal and transverse joints are produced and in accordance with the approved Asphalt Placement Work Plan.
2. Neat, straight butt joints between successive passes. Offset joints a minimum of six (6") inches between lifts of asphalt.
3. When repairs or staging of work occurs, make neat vertical saw cut between old and new work to create butt joint. Heat joint prior to pouring. Cold joints are not acceptable.
4. Apply bituminous tack coat to all surfaces and rates indicated under "Bituminous Tack Coat" of this specification section. Tack coat shall not be required on abutting vertical edges for pavements placed in the same day.
5. Minimize construction, longitudinal, and transverse joints left open for an extended period of time.
6. Construct longitudinal joints by paving in a hot fashion with a temperature of not less than 220°F to ensure maximum performance and adhesion.

7. Compact all joints to provide for a neat, uniform and tightly bonded joint that will meet both surface tolerances and density requirements of this specification.
 8. Cut straight and true (vertical construction or transverse joints if the material has cooled to less than 220°F prior to the placement of the next pass to ensure the best performing joint possible.
- F. Edges: Roll at 45 degrees as detailed, creating clean edge conforming to shapes indicated on the drawings. Ragged edges will not be accepted. Return and saw cut ragged edges at no additional cost to the Owner as directed by the Architect.
- G. The final finished grades of the new Bituminous Concrete Pavements must be smooth and true to the contours and shall be installed to the lines and grades of the site prior to start of construction. The final finished grades shall match adjacent pavement surfaces and concrete slabs, aprons, and doorways.
- H. Construction Delays (over 48 hours): When placement of the wearing course over the binder course is delayed over 48 hours, thoroughly clean existing surface of dirt, oil and other debris by pressure washing and sweeping. Place bituminous tack coat as specified in this section.

3.05 DOUBLE BITUMINOUS SURFACE TREATMENT

- A. After the base course has been placed and approved, prime the surface with 0.50 gals. per sq. yd. of asphalt emulsion. Cover the area with 30 lbs. per square yard of clean No. 1 stone and compact with a 10 ton roller.
- B. After the prime coat has set, apply 0.40 gals. per sq. yd. of asphaltic emulsion, and cover with 25 lbs. per sq. yd. of No. 1A stone. Compact with roller. After two days time, sweep and remove excess stone.

3.06 ASPHALT TOLERANCES

- A. Thickness and Density: Compact each asphalt course to produce the thickness indicated on the drawings within the following tolerances:
1. Base Course: Plus or minus 1/2-inch
 2. Binder Course: Plus or minus 1/4-inch
 3. Wearing Course: Plus or minus 1/8-inch
- B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined using a 10-foot straightedge applied transversely or longitudinally to paved areas:
1. For Asphalt Concrete:

Base Course Surface:	3/8"
Binder Course Surface:	1/4"
Wearing Course Surface:	1/8"
 2. For Double Bituminous Surface Treatment:

Granular Base Course Surface:	3/8"
Wearing Course Surface:	1/4"

- C. Topographically Survey: Survey the running track and field events prior to placing the resilient track surface and provide the Architect with a plan indicating elevation shots as follows: Elevation shots shall be a minimum of four (4) at regular equal intervals across the track (from inside to outside of lanes). This shall be continued around the track at 10' o.c. until the entire track is covered. When this survey indicates that surface conditions are not acceptable based on project and governing body tolerances, the Contractor shall be responsible for correcting the rejected areas without delay or additional costs.
- D. Asphalt Cores: Shall be provided as indicated under "Field Quality Control" of this specification.

3.07 FIELD QUALITY CONTROL

- A. The Owner's Testing Agency shall provide the following in the daily report at a minimum:
 - 1. Verify the following for the asphalt mix design prior to asphalt placement:
 - a. The asphalt mix design has been approved.
 - b. The asphalt mix design specifies the minimum relative compaction and the methods required to determine maximum density.
 - 2. Verify the asphalt subgrade has been acceptably proof-rolled. (See Section 31 22 01.)
 - 3. Inspect /test aggregate base course material for in-place density (95%) and thickness. Test materials for gradation classification, and physical properties. (See Section 31 22 01.)
 - 4. Inspect/test asphalt wearing course material for compaction during placement and conduct thickness measurements during lay-down. Take temperature of the asphalt mixture and compare actual temperature with the approved asphalt mixture design range. As a minimum, perform the following inspection/tests:
 - a. Collect trip tickets from trucks delivered to the site and verify correct mix design being used for the project.
 - b. Temperature tests: one per truck.
 - c. Lay down thickness (uncompacted): one per strip or 500 square feet minimum
 - d. Verify equipment rolling pattern and passes to ensure proper compaction: one per day
 - e. Density test (daily lab density): one test per 5000 square feet minimum
 - f. Hot mix samples (laboratory testing for density per ASTM D1188): one per day
 - g. Thickness per ASTM D3549 and density samples per ASTM D2950 by a properly calibrated nuclear asphalt testing device. If there is a disagreement between tests done by ASTM D2950 and ASTM D1188, the values done by ASTM D1188 will govern: one test per 20,000 square feet (surface lift), one test per 10,000 square feet (base lift)
 - h. Air voids per ASTM D3203 or D2726: one test per 5000 square feet minimum
 - i. Verify compaction at the joints and seams. The completed paved surface to be true to grade and cross section. Verify smoothness by using an unlevelled 10 foot straightedge and ensuring no gap at any point between straightedge and pavement exceeds surface smoothness requirements above except at interception or at changes of grade.

- j. The screed/lay down thickness tolerance shall be between 1/8 to 3/16 inches greater than the required asphalt minimum layer requirement. When screed depth is set for the exact thickness as specified, immediately notify the Owner's Representative and Contractor that the installed asphalt thickness may be deficient to achieve the specified minimum thickness. Identify areas of non-complying thickness and attach a drawing identifying the areas to the daily field report.
- k. Immediately notify the Owner's Representative and Contractor when paving is being conducted in cold weather and asphalt temperatures are below or above the design mix range.
- l. Check the surface grades and drainage patterns. Identify on a drawing all paved areas that are holding water after asphalt placement and notify the Owner's Representative and Contractor. Small ponding areas (bird baths) larger than two (2') feet in any dimension are not acceptable. When this test proves that surface conditions are not acceptable, the Contractor will be responsible for correcting the problem areas. Install a one (1") inch shim coat of wearing course material, or other means acceptable to the Architect.
- m. Verify tack coat and edge coat have been applied at the proper rate.

5. Asphalt Cores: Shall be as directed by the Architect.

- a. Prior to final acceptance of the asphalt and before lining or other surface materials (resilient track surfacing, etc.) are placed, the Owner's Testing Agency shall core 3" diameter areas of the asphalt surfacing where directed by the Architect. Consistency, density, thickness, and tensile strength per ASTM D6931 will be evaluated.
- b. Patch core areas as directed by the Architect to match adjacent density, texture and thickness.
- c. Coordinate day to day scheduling with the Testing Agency.
- d. If cores vary significantly from the contract requirements, additional cores will be performed by the Testing Agency as directed by the Architect. Once the overall general quality is determined, provide remedial work as directed by the Architect to achieve the quality and consistence as specified.

- B. Unacceptable Paving: Remove and replace unacceptable paving as directed by the Architect, immediately and without argument or delay. Correction of deficient areas in the wearing course shall be done by sawcutting and removal of defective area of work. Tack coat shall be applied to all edges and the pavement shall be replaced. Shimming or skin patching of the wearing course shall not be permitted. Correction of deficient areas within the binder course shall be corrected by sawcutting and milling high spots, and truing and leveling low spots or as directed by the Architect.

3.08 SURFACE PROTECTION

- A. Protection: After final rolling and sealing, do not permit any type of vehicular or construction traffic on pavement until it has cooled and hardened as recommended by the producer/manufacturer, minimum of 48 hours.
- B. Provide protection including, but not limited to, fencing, traffic cones, barrels, lights, reflective signs, flagpersons and barricades until mixture has cooled and attained its maximum degree of hardness.

3.09 PAINTED LINES AND TRAFFIC MARKINGS

- A. Cleaning: Sweep and clean surface to eliminate loose material and dust. Remove dirt, oils and other foreign matter. All surfaces to receive pavement markings shall be clean and in good condition to accept pavement markings.
- B. Coordinate provisions for installation with work of other trades.
- C. Locate to alignment and dimensions as shown on drawings and/or approved by Owner.
- D. Painted markings shall meet regulations described in the "Manual of Uniform Traffic Control Devices", latest edition, as published by NYSDOT, Division of Traffic and Safety, Section 262.25 and figure PM-42; and they shall comply with the most recent version of the Americans with Disabilities Act Standards for Accessible Design.
- E. Protect: Adjacent surfaces and other items to remain with tape, drop cloths, or other Architect approved means.
- F. Application: Two coats according to manufacturer's recommendations resulting in a dense, opaque application without any ghosting of former pavement markings showing through. Overspraying along edges will not be accepted. Edges shall be sharp and crisp, to the shapes required by the drawings.
 - 1. First coat shall be installed at the recommended DFT (dry film thickness) after paving is in place. The second coat shall be applied at the recommended DFT no later than thirty (30) days after the completion of work.
 - 2. Apply paint materials using clean brushes, rollers or spraying equipment.
 - 3. Apply paint materials as a rate not exceeding those recommended by the paint manufacturer for surfaces being painted, less 10% of losses
 - 4. Comply with manufacturer's recommendations for drying time between coats. The minimum DFT must be met. Apply additional coats as needed to achieve minimum total specified DFT of the paint system.
 - 5. The minimum required total Dry Film Thickness (DFT): The DFT shall be the minimum required thickness as measured in mils.
 - 6. System coverage requirements minimum total thickness (unless otherwise noted):
 - a. 1st Coat – 3.0 mils
 - b. 2nd Coat – 6.0 mils
 - 7. Exterior Paint Systems: Provide the following paint systems as indicated: (Colors to be approved by Owner.)
 - a. Parking stall, division and limit lines shall be 4" in width, true and straight. Color: White – DFT 6.0 mils
 - b. Pavement lettering "NO PARKING" shall be 2'-0" in height. Color: Yellow – DFT 6.0 mils
 - c. Compact lettering "COMPACT" shall be 1'-0" in height. Color White – DFT 6.0 mils
 - d. Stop legends shall be as detailed on drawings. Color: White – DFT 6.0 mils
 - e. Wheelchair legends shall be as detailed on the drawings. Color: Blue background with white symbols. Parking stall striping shall be Blue at handicap stalls only – DFT 6.0mils

- f. Diagonal striping Handicapped. Color: Blue – DFT 6.0 mils
 - g. Diagonal striping Loading Zone. Color: Yellow – DFT 6.0 mils
 - h. Directional signage shall be as detailed on the drawings. Color: White – DFT 6.0 mils
 - i. Center line striping shall be 4” in width as detailed on the drawings. Color: White – DFT 6.0 mils
 - j. Fire line striping shall be 4” in width. Color: Yellow – DFT 6.0 mils
- G. Allow 48 hours minimum curing time for paint before allowing traffic on surfaces. Clean up thoroughly including all protective tape, spilled paint, and debris. All parking area marking and painting to be protected by appropriate traffic barriers, lighted if necessary, so located as to prohibit parking and traffic until traffic lines are completed and properly dry.

3.10 HOT POUR CRACK SEALING AND FILLING

- A. The crack must be free from moisture, dust, and loose aggregate. Routing or wire brushing are preferred methods followed by a compressed air heat lance immediately prior to sealing. The substrate and air temperature must be above 45°F.
- B. Shall be melted in direct fired or oil jacketed melters. Material should reach recommended pouring temperature of 350-400°F. Fresh material may be added as sealant is used.
- C. Apply heated crack filler using either a pump and wand system or a pour pot. For best results the sealant depth to width ratio should not exceed 2 to 1 (i.e. 2-inches deep to 1-inch wide). The cooled sealant height should not exceed 1/8" above surrounding pavement. Using a sealing shoe or squeegee, band the material 2 to 3 inches wide over the crack.

3.11 CLEAN UP

During the contract, and at intervals as directed by the Architect, and as asphalt paving is completed, clear the site of extraneous fabric, gravel, asphalt and debris. Leave the site in a clean, safe, well draining, neat condition.

END OF SECTION

SECTION 321301

SITE CONCRETE WORK

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. The extent of site concrete work is shown on the drawings and includes formwork, reinforcement, accessories, cast in place concrete, installation of embedded items, finishing, curing, mix designs, testing and acceptance requirements for concrete.
- B. Site Concrete work includes, but is not limited to, the following:
 - 1. Concrete walks and pads
 - 2. Concrete curb ramps with detectable warning system
 - 3. Concrete shot put and discus pad(s), steeple chase pit, pole vault box and long/triple jump pits
 - 4. Concrete footings, bases, foundations, cradles, saddles, collars, and thrust blocks
 - 5. Exterior anchoring cement non-shrink grout
 - 6. Concrete scheduling April 1 to October 15
 - 7. Clean up
- C. Provide materials, labor, equipment and services required to accomplish related work in accordance with the drawings and specifications.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 31 22 01 - Site Earthwork
- B. Section 323000 Series - Site Improvements for Athletic Field Equipment and Furnishings, Synthetic Turf, Metal Bollards, Traffic Signs, Exterior Bleachers, Press Box, Exterior Scoreboards, Granite Curb, Fencing, Flagpoles, etc.
- C. Section 33 11 01 - Water Distribution
- D. Section 33 30 01 - Site Sanitary
- E. Section 33 40 01 - Storm Drainage

1.03 REFERENCES

- A. ACI 301-96 - Specifications of Structural Concrete for Buildings
- B. ASTM A615 - Deformed and Plain Billet-Steel for Concrete Reinforcement
- C. ASTM C31 - Standard Practice for Making and Curing Test Specimens in the Field
- D. ASTM C33 - Concrete Aggregate
- E. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
- F. ASTM C94 - Ready-Mixed Concrete

- G. ASTM C109 - Test Method for Compressive Strength of Hydraulic Cement Mortars
- H. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete
- I. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink)
- J. ASTM C150 - Portland Cement
- K. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete
- L. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by Volumetric Method
- M. ASTM C260 - Air Entraining Admixtures for Concrete
- N. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete
- O. ACI 315 - Details and Detailing Concrete Reinforcement

1.04 SUBMITTALS: (See Section 31 12 01, 1.05)

- A. Manufacturers Product Data (MPD) and Samples where indicated are required for the following:
 - 1. Expansion Joint and Sealant (Vertical and Horizontal): MPD and Color Samples
 - 2. Water Based Curing and Sealing Compound
 - 3. Slip Dowel System
 - 4. Fiber Reinforcement: (Gutters and Curbs Only)
 - 5. Cold Weather Admixture
 - 6. Hot Weather Admixture
 - 7. Air Entrainment
 - 8. Detectable Warning System
 - 9. Form Release
 - 10. Exterior Anchoring Cement Non-Shrink Grout
 - 11. High Strength Anchoring Epoxy System
 - 12. Concrete Bonding Agent
- B. Submit proposed 4,000 psi concrete mix design and test data in accordance with ACI 301 to the Architect for review prior to commencement of the work.
 - 1. Indicate the locations and elements for which the mix will be used.
 - 2. Include in the concrete mix design all required or proposed admixtures necessary to facilitate the installation of the concrete by the means and methods selected by Contractor for this project.
- C. Mill test certificates and/or test reports for cement indicating compliance with these specifications.

1.05 QUALITY ASSURANCE

- A. Concrete Testing Services: The Owner shall employ an acceptable independent testing laboratory to perform materials evaluation, testing of concrete mixes, and quality control testing. Coordinate day to day scheduling with the testing agency. Field technician shall be ACI Certified Grade 1 Field Technician.

- B. Construct and erect concrete formwork in accordance with ACI 301 and 347.
- C. Perform concrete reinforcing work in accordance with ACI 301.
- D. Perform cast-in-place concrete work in accordance with ACI 301.
- E. Conform to New York State Building Code.
- F. Field quality control tests are specified in Part 3 - Execution.

1.06 JOB CONDITIONS

- A. Job conditions in Section 31 22 01 apply. Provide ample and skilled manpower for concrete installation which is a recognized time sensitive procedure.
- B. All concrete work shall conform to American Concrete Institute (ACI) 304R-00 "Guide for Measuring, Mixing, Transporting and Placing Concrete".
- C. Do not install concrete work when the temperature of the outside air is below 50 degrees F. and falling unless suitable means acceptable to the Architect are provided to protect work from cold and frost and ensure that mortar and concrete will cure without freezing as indicated in "Cold Weather Concreting" below.
- D. Cold Weather Concreting: Provide non-chloride accelerating water reducing admixture in site concrete work placed at ambient air temperatures below 50 degrees F. (10 degrees C.). Comply with International Masonry Industry All-Weather Council cold weather construction and protecting recommendations and American Concrete Institute 306R-10 "Guide to Cold Weather Concreting."
- E. Hot Weather: Provide water reducing retarding admixture in site concrete work placed at ambient air temperatures above 80° F. Comply with American Concrete Institute 305R-10 "Guide to Hot Weather Concreting."
- F. Construction Review: Notify the Architect/Geotechnical Engineer when stairs, retaining walls, walks, ramps, curbs and pads are formed and ready to receive concrete. Radius form layout shall be inspected and approved by the Architect.
- G. Schedule: Unless otherwise directed in writing by the Architect, construct site concrete work from April 1 to October 15. This permits a minimum 30 day dry curing period prior to possible application of deicing chemicals by the Owner.
- H. Site concrete work performed between October 16 and March 30 will require an additional written one (1) year guarantee with the understanding that above average concrete deterioration and replacement by the Contractor is likely. Or;

Provide temporary light duty asphalt access paths and replace with permanent concrete during the following April 1 to October 15 timeframe. Both options are at no additional cost to the Owner.

1.07 ADA REQUIREMENTS

- A. GENERAL: Concrete work shall comply with the Americans With Disabilities Act as described in the 2010 ADA Standards issued by the Department of Justice (DOJ) and the Department of Transportation (DOT) or latest edition, shall be used.
- B. Curb ramp and concrete walk surfaces shall meet the following tolerances:

1. Transitions from ramps to walks, gutters, or streets shall be flush and free of abrupt changes.
2. Thresholds at doorways shall not exceed 3/4" in height for exterior sliding doors or 1/2" for other types of doors. Raised thresholds and floor level changes at accessible doorways shall be beveled with a slope no greater than 1:2.
3. Detectable warning system shall cast in place for the safety and convenience of the visually impaired. Contractor shall have a minimum of three (3) years experience with materials and installation.

PART 2 - PRODUCTS

2.01 FORM MATERIALS AND ACCESSORIES

- A. Forms: Either steel or wood, exterior type softwood, PS1, of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use forms that are straight and free of distortion and defects, extending the full depth of concrete. Concrete walks which require radius form work shall be set with flexible forms, conforming to the shapes and dimensions as indicated.
- B. Lumber: PS 20.
- C. Form Ties: Snap-off, metal type of fixed length, cone type.
 1. Ties shall be left in place and equipped with swaged washers or other approved devices to prevent seepage of moisture along the tie.
 2. Depth of Breakback: Minimum one (1") inch.
 3. Unless otherwise noted, provide form ties, which will not leave holes larger than one (1") inch diameter in concrete surface.
- D. Dovetail Anchor Slot: Galvanized steel, form filled, release tape sealed slots; bend tab anchors.
- E. Form Release Agent: Shall be non-staining and non-residual. Increte Wall Form Release manufactured by Increte or Architect approved equal.

2.02 REINFORCEMENT MATERIALS

- A. Reinforcing Steel: ASTM A615, 60 ksi yield grade; deformed billet steel bars, plain finish, free of rust and/or oxidation. Reinforcing bars shall be bundled and tagged with grades and suitable identification markings, shall be waterproof, and shall not be removed until steel is placed.
- B. Steel Welded Wire Reinforcement ASTM A185, plain type:
 1. Flat Sheets
 2. Mesh size: 6 x 6 (standard W1.4 x W1.4, heavy duty W2.1 x W2.1)
 3. Free of rust and/or oxidation
- C. Reinforcement Accessories:
 1. Tie Wire: FS QQ- W-461 G, annealed steel, back, 16-gage minimum.
 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement. They shall provide sufficient supports at close enough spacing so that the steel will carry the weight of the workmen and the fresh concrete without deformation from its specified location.

- D. Fabricate concrete reinforcing in accordance with ACI 315.
- E. Slip Dowels: Shall be a slip dowel system comprised of a round dowel sleeve and corresponding base. Standard of quality: shall be Speed Dowel as distributed by A.H. Harris, (860) 216-9500 or Architect approved equal.

2.03 CONCRETE MATERIALS

- A. Cement: ASTM C150, Normal-Type 1 or Type II, Portland type.
- B. Aggregates (ASTM C33):
 - 1. Fine aggregates: clean, sharp, natural sand.
 - 2. Coarse Aggregates: 3/4" maximum size stone meeting the requirements of New York State Department of Transportation Specification 703.02.
- C. Water: Clean and not detrimental to concrete.

2.04 ADMIXTURES

- A. Calcium Chloride in concrete is prohibited.
- B. Air Entrainment Admixture: ASTM C260, Darex AEA ED or Architect approved equal.
- C. Water Reducing Admixture: ASTM C494, Type A; not containing more chloride ions than are present in municipal drinking water.
- D. High Range Water Reducing Admixture: ASTM C494, Type F or G; not containing more chloride ions than are present in municipal drinking water.
- E. Cold Weather Accelerating Admixture: (Ambient temperature below 50°F.) Non-chloride water reducing accelerating admixture, ASTM C494, Type C, PolarSet as manufactured by WR Grace & Co. or Architect approved equal. Mix at rates recommended by the manufacturer. No reduction in compression rating of the concrete is permitted.
- F. Hot Weather Water Reducing and Retarding Admixture: (Ambient temperature above 80° F.) Shall be Daratard series admixture, ASTM C494, Type D, as manufactured by WR Grace & Co. or Architect approved equal. Mix at a rate recommended by the manufacturer. No reduction in compression rating of the concrete is permitted.

2.05 RELATED MATERIALS

- A. Expansion Joints:
 - 1. For Radius Applications: Expansion joint filler shall be polyethylene closed cell backing with peel off strip, X-Foam as manufactured by W.R. Meadows or Architect approved equal.
 - 2. For Straight Applications: Expansion joint filler shall be fiber expansion joint with peel off snap-cap, as manufactured by W.R. Meadows or Architect approved equal.
- B. Caulking for flat slabs shall be one part elastomeric self leveling polyurethane gray sealant Pourthane SL or Architect approved equal. Caulking for vertical surfaces shall be one component elastomeric gun grade polyurethane sealant Pourthane NS, color as selected by the Owner to match wall stain or Architect approved equal.

2.06 COMPOUNDS, HARDENERS, AND SEALERS

- A. Water Based, Acrylic, Curing and Sealing Compound: ASTM C309, Type 1, Class A and B, clear or translucent. Standard of quality shall be VOCOMP-20 as manufactured by W.R. Meadows or Architect approved equal.

2.07 CONCRETE MIX

- A. Mix and deliver ready-mix concrete in accordance with ASTM C94.
- B. Concrete:
 - 1. Compressive Strength (Minimum at 28 days): 4,000 psi
 - 2. Slump (Maximum): 2 to 4 inches
 - 3. Air Entrainment: 5-8.5%
 - 4. Flexural Strength (ASTM C78): 650 psi at 28 days.
- C. Use water-reducing admixture in all concrete.
- D. Water/Cement Ratio: Maximum 0.42 for 4,000 psi concrete.
- E. Cement Factor Per Cubic yard: Minimum 560 lbs. for 4,000 psi concrete.
 - 1. Substitution of fly ash for cement is prohibited.
- F. Maximum Size of Coarse Aggregate:
 - 1. General Work: Per ACI 301, 3/4" maximum.
- G. Select admixture proportions for normal weight concrete in accordance with ACI 301.
- H. Add air-entraining agent to concrete mix for all concrete work exposed to exterior.

2.08 MIXING WATER CONTROL

- A. The quantity of mixing water used in the concrete mix shall be determined by the Contractor, except that the Architect/Geotechnical Engineer may direct that such quantity of water be reduced if the slump of the concrete exceeds the specified slump. The Contractor's determination of the quantity of mixing water shall conform to the various limits on water/cement ration and slump specified. Concrete consistency shall be uniform from batch to batch.
- B. During the course of the work, the batch plant will make quantitative measured moisture determinations of the aggregates utilized in each batch. Aggregate weights and batch water requirements shall be adjusted accordingly for measured aggregate moisture content.
- C. When concrete is transported in units approved for mixing, the addition of not more than 10% of the total design water will be permitted at the job site to obtain initial slump.
 - 1. Any addition of water shall be followed by mixing of at least 30 revolutions in the mixing speed range.
 - 2. No more than two additions of water at the point of deposition before discharge shall be allowed.
 - 3. No retempering of the concrete will be permitted. Retempering is defined as the addition of water after the mix has attained its desired initial slump.

2.09 DETECTABLE WARNING SYSTEM

- A. Cast in place vitrified polymer composite (VPC) detectable/tactile warning tiles shall be an epoxy polymer composition with aluminum oxide particles in the truncated domes. Standard of quality shall be Armor-Tile 24" x 48" cast-in-Place Inline Dome Tactile Tile (ADA-C-2448) as manufactured by Engineered Plastics, Inc. 800-682-2525 or Architect approved equal.
- B. Color shall be colonial red (Federal No. 20109) or Architect approved equal.
- C. Guarantee period shall be five (5) years from substantial completion including defective work, breakage, deformation, heave, and loosening tiles.

2.10 EXTERIOR ANCHORING CEMENT (NON-SHRINK GROUT)

- A. For Steel Posts, Fencing and Other Non-Aluminum Elements: Shall be an exterior grade anchoring cement (non-shrink grout) with a min. compressive strength (ASTM C-109) of 7,200 psi at 28 days. Standard of quality shall be Super Por-Rok as manufactured by CGM, Inc., www.cgmbuildingproducts.com, or Architect approved equal.
- B. For Aluminum Posts and Elements: Shall be an exterior grade anchoring cement (non-shrink grout) with a min. compressive strength (ASTM C-109) of 7,200 psi at 28 days. Standard of quality shall be Por-Rok as manufactured by CGM, Inc., www.cgmbuildingproducts.com, or Architect approved equal.

2.11 HIGH STRENGTH ANCHORING EPOXY SYSTEM

- A. A two-component vinylester adhesive anchoring system. The system includes injection adhesive in plastic cartridges, mixing nozzles, dispensing tools and hole cleaning equipment.
- B. Designed for bonding threaded rod and reinforcing bar elements into drilled holes in concrete and masonry base materials.
- C. Standard of quality shall be AC100+ GOLD Vinylester Injection Adhesive Anchoring System as distributed by A.H. Harris, (315) 414-0340, or Architect approved equal.

2.12 CONCRETE BONDING AGENT

- A. Shall be a concrete bonding adhesive specifically formulated for permanently bonding new concrete to old concrete in exterior applications.
- B. Concrete bonding adhesive applied to appropriate substrates will achieve tensile bond strengths typical of 150 psi in 28 days.
- C. Standard of quality shall be Quikrete Concrete Bonding Adhesive or Architect approved equal.

PART 3 - EXECUTION

3.01 CONCRETE WALKS AND PADS

- A. Surface Preparation: Remove loose material from the compacted subgrade surface immediately before placing concrete. Remove any standing water, mud, debris, frost, snow, ice from surfaces upon or against which concrete is to be placed.

- B. Proof-roll prepared subgrade surface to check for unstable areas and the need for additional compaction. Do not begin concrete pour until such conditions have been corrected, subgrade is compacted to 95% and ready to receive concrete.
- C. Form Construction: Construct to required size and shape. Brace and secure to maintain alignment, elevation and position. Check completed formwork for grade and alignment, prior to installing concrete. Clean forms as needed to removed foreign matter.
- D. Install welded wire mesh on concrete brick or mesh chairs to proper level in maximum lengths possible. Offset end laps in both directions. Splice laps with tie wire. Lifting mesh after concrete pouring is not acceptable.
- E. Prepare concrete mixture including the following:
1. Add hot weather or cold weather admixture to accommodate field weather conditions.
- F. Concrete Testing: Will be performed as described in Part 3, "Field Quality Control" of this specification section.
- G. Conveying:
1. Convey concrete by means that will prevent segregation and loss of mortar from the mix.
 2. Provide adequate manpower and equipment in the form of buckets, buggies, chutes, conveyors or other approved means to assure continuous operation.
 3. Convey concrete so that no equipment with aluminum parts comes in contact with fresh concrete.
- H. Concrete Placement: Do not place concrete until subgrade and forms have been checked for line and grade. Moisten granular base course as required to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they have been brought to the required finish grade, alignment, and expansion joints have been installed.
- I. Spread concrete as soon as it is deposited on the granular base course, using methods which prevent segregation of the mix, and with as little rehandling as possible. Consolidate concrete along the face of forms. Consolidate with care to prevent dislocation of mesh, reinforcing and joint materials.
- J. Install Concrete Walk Joints:
1. Construct expansion and contraction joints as detailed and as shown on plans. Concrete joints that do not follow the pattern(s) shown on the plans and/or changes that have been approved by the Architect will be removed and replaced at no additional cost to the Owner.
 2. When the walkway is abutting existing walks, place transverse joints to align with previously placed joints, unless otherwise shown.
 3. Contraction Joints: Approximately 5' on center. Break walk into individual slabs of not more than twenty-five (25 sf) square feet with jointing tool, round edges. Saw cut scoring pattern (contraction joints) to depth shown on details for each type of concrete work with new, sharp concrete sawblade one day (24 hours) after the pour. Joint cuts to be clean, sharp, uniformly made cuts to achieve scoring pattern as shown and detailed. Note: When tooled joints or saw cutting is not performed as described, an extended three (3 yr.) year written guarantee

or credit for defective work will be required as determined by the Architect at no additional cost to the Owner.

4. Expansion Joints: Provide where abutting building(s), columns, structures, concrete paving and curbs, catch basins, manholes, inlets, walks, walls, other fixed objects and as directed by the Architect.
5. Locate expansion joints at thirty feet on center (30' o.c.) for each walkway lane, unless otherwise shown. Provide slip dowels as detailed and specified.
6. Locate expansion joints with slip dowels at all flush building access points, whether specifically shown on drawings or not.
7. Extend joint fillers full width and depth of the joint, flush with finished pavement grade, and not less than 1/4" or more than 1/2" below the finished pavement surface. Joint surfaces shall be clean and dry prior to installation of sealant as per manufacturer's recommendations. Remove excess sealant on surfaces adjacent to joint.

K. Concrete Finishing:

1. Perform concrete finishing using machine or hand methods as required.
2. After striking off and consolidating concrete, smooth the surface by screeding and floating. Use hand methods only where mechanical floating is not possible. Adjust the floating to compact the surface and produce a uniform texture.
3. After floating, test surface for trueness with a ten (10') foot straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide a continuous, smooth finish.
4. Work edges of slabs and joints with a 1/8" radius edging tool, two (2") wide, unless otherwise shown.
5. After completion of floating and when excess moisture or surface sheen has disappeared, complete surface finishing, as follows.
6. Broom finish, by drawing a medium hair broom across the concrete surface as detailed. Repeat operation when required to provide a medium texture acceptable to the Architect.
7. For handicap curb ramps, tool grooves along sloping surfaces in line with drainage flow as detailed.
8. Curing: Refer to schedule noted in 1.6, above.
 - a. Immediately after placement, protect concrete from premature drying.
 - b. Remove all dirt, dust, oil, grease, asphalt and foreign matter. Cleanse with caustics and detergents as required. Rinse thoroughly and allow to dry.
 - c. Stir curing compound thoroughly before using.
 - d. Apply a continuous, uniform film by solvent-resistant low pressure spray only, short-nap roller or lamb's wool applicator. For best results, use a canister curing compound sprayer. Use spray tip number 8004 or equivalent for water-based or waterborne products.
 - e. For curing, apply first coat evenly and uniformly as soon as possible after final finishing. Apply second coat when all construction is completed and structure is ready for occupancy.
 - f. When soil contamination occurs, notify the Architect immediately in writing. Remove contaminated soils and legally dispose of, provide soil test(s), replace soil, plantings and lawns at no additional cost to the Owner.

L. Detectable Warning System:

1. Pour and float concrete, set tile by tamping grid pattern down into the concrete until all air voids are removed with a rubber mallet.

2. Place two cinder blocks or 25 lbs weights on the tile to prevent floating.
3. Create an edge around the perimeter of the tile using a 3/8" radius edging tool then float the concrete around the tile's perimeter using a steel trowel.
4. After concrete has cured, remove protective plastic wrap.
5. Protect tiles against damage during construction and clean tiles as recommended by the manufacturer.

3.02 FOOTINGS, BASES, FOUNDATIONS, SADDLES, CRADLES, COLLARS, AND THRUST BLOCKS

- A. Footings, Bases, Foundations: Locate and provide where shown on drawings and as detailed.
- B. Saddles: Locate and provide where shown on drawings or where vertical distance between crossing pipes is eighteen (18") inches or less. Construct saddles springline (centerline) to springline and full width of trenches.
- C. Cradles: Locate and provide where shown on drawings. Construct cradles the full width of the trench, six (6") inches below the pipe and on both sides of the pipe up to the springline.
- D. Collars: Locate and provide where shown on drawings or where pipe slopes exceed ten (10%) percent. Construct collars one (1') foot thick, full width of trench plus one (1') foot extension each side, above and below pipe.
- E. Thrust Blocks: Locate and provide where shown on drawings. Also for sanitary force main and water pipes at (1) connections to existing systems, (2) at changes in horizontal alignment of 22-1/2 degrees or more, and (3) at tees, crosses, valves, hydrants and plug (end of pipe) conditions. Block and anchor with concrete so that there will be no movement of the pipe in the joints due to internal or external pressures. The concrete shall be placed around the fittings and completely fill the space between the fittings and walls of the trench, from 6" below the fittings of pipe, to 12" above the fittings. The anchor concrete shall be so placed that the bell and spigot joints or other joints may be recaulked or tightened if necessary. Concrete thrust blocks shall conform dimensionally to details shown on drawings.

3.03 INTERRUPTION OF CONCRETING

- A. Should placing concrete be suspended or unavoidably interrupted, provide key ways and bulkheads to prevent feather-edging when work is resumed. Roughen horizontal surface for bond.

3.04 REPAIR AND PROTECTION FOR CONCRETE WORK

- A. Cut out and replace defective concrete work which has blisters, cracking, crazing, curling, discoloration, dusting, efflorescence, low spots, pop outs, scaling or mortar flaking, spalling, settling, or heaving as defined by Portland Cement Association 2001, "Concrete Slab Surface Defects" and as directed by the Architect.
- B. Modify or replace concrete not conforming to the required lines, details, elevations and specifications as directed by the Architect.
- C. Protect the work from damage until acceptance of the work. Exclude traffic from concrete work for at least fourteen (14) days after placement. When construction traffic is permitted, maintain concrete as clean as possible by removing surface stains and spillage of materials as they occur.

3.05 ANCHORING RAILINGS AND POSTS INTO CONCRETE

- A. Aluminum posts **must** be coated or treated with a good sealer or paint prior to anchoring.
- B. Drill the hole as detailed. Blow out all dust and loose particles.
- C. Fill the hole with water. Scrub the sides and bottom of the hole and with a stiff wire brush such as a bottlebrush. This is important.
- D. Remove excess water with rag or other absorbent materials. Leave the hole clean and uniformly damp.
- E. Mix the anchoring cement in a clean container to flowable consistency based on the following formula. For best results, measure accurately. The correct amount of water is as follows:

2.3 oz per lb
11.5 oz for 5 lbs
115 oz for 50 lbs
7 quarts for 100 lbs

Measure the amount of anchoring cement and water to be mixed. Add the measured amount of water to the appropriate amount of cement and mix until the desired consistency is achieved. (NEVER USE MORE WATER THAN PRESCRIBED). This will reduce the ultimate strength, increase the possibility of volume instability and may cause the product to become soft and less durable.)

- F. Fill the hole with the plastic cement first, and then tamp the bolt, post or rod with a twisting motion into place. If the material becomes too fluid during the tamping process and sags out of place, let it stand for a few minutes and it will stiffen. Smooth out the surface around the bolt with spatula or trowel.
- G. Let the cement harden for at least 60 minutes. For heavy equipment, allow 4 hours prior to use or loading.

3.06 ANCHORING BOLTS, DOWELS, AND REBAR INTO CONCRETE

- A. Anchor Hole Preparation: Prepare all anchor holes prior to placement of anchoring epoxy. Hole diameter is typically 1/8" (3 mm) greater than the anchor diameter. Hole depth is typically nine times anchor diameter. Required minimum anchor hole depth is 6". Consult project specifications and details. Drill hole to proper diameter and depth and blow all dust from the bottom of the hole, brush and blow (4x) repeatedly to remove all dust and debris. The anchor hole must be clean and free of standing water prior to placement of material.
- B. Application: Use only professional caulking gun. Remove plastic cap and plugs from cartridge. Save for closing cartridge. Attach mixing nozzle to cartridge. Discard small amount of gunned product until uniform color is achieved. Mixing nozzle will harden in approximately 20 min. if not in use.
- C. Hardened nozzle must be discarded. Dispense the epoxy at the bottom of the hole while withdrawing nozzle. Dispense epoxy (typically filling 5/8 of hole) so that once threaded rod or rebar is inserted, the hole is completely full. Insert threaded rod or rebar to the bottom of the hole while turning clockwise. Promptly remove any excess material. Leave

anchor undisturbed for 6 hours (at 77°F /25°C), or longer for colder temperatures. Load can be applied 8 hours at 77°F (25°C).

3.07 CONCRETE BONDING AGENT

- A. Required at elements where new concrete is applied and joined to existing concrete.
- B. Surface Preparation:
 - 1. Apply only to clean, sound, dry surfaces.
 - 2. Remove dust, dirt, oil, grease, wax, unsound concrete and plaster, paint, and other foreign materials.
- C. Applications:
 - 1. Apply to a dry surface with brush, roller or spray to the thickness of a coat of paint.
 - 2. Place new concrete, topping mixes, Portland cement, or patches as soon as the adhesive is dry.
 - 3. Make sure basecoat is dry before applying adhesive.
 - 4. Tools, brushes and other application accessories should be immediately cleaned with soapy water. Use hot water to clean up any drippings.

3.08 FIELD QUALITY CONTROL

- A. Field inspection and testing shall be performed by ACI certified technicians; Grade 1. Certificates shall be submitted to the Architect for persons performing inspection and testing prior to the start of work.
- B. Field Inspection and testing shall be paid for as directed under 1.5 "Quality Assurance". Where retesting, additional inspection, lab tests or other professional services are required due to rejected work, any cost associated therewith will be solely at the Contractor's expense.
- C. The Contractor shall plan his operations to allow adequate time for all required testing and inspection.
- D. The Contractor shall provide facilities and equipment necessary to obtain and handle representative sample of materials to be tested.
- E. The testing laboratory shall be responsible to the Owner for the field control of all concrete and may reject batches because of high slump, uncontrolled air entrainment, delays or other conditions of non-compliance with these specifications.
- F. Sampling and Field testing will be performed during concrete placement per ASTM C31, C39, C143, C172 and C173.
- G. Five (5) Concrete Test Cylinders: Taken for every 30 or less cubic yards of concrete placed are required or a fraction thereof;
 - 1. Two (2) Cylinders will be tested at 7 days, two (2) cylinders will be tested at 28 days and one (1) cylinder will be held for possible testing at a later time.
- H. One (1) Additional Test Cylinder: Taken during cold weather concreting, to be cured on the job site under the same conditions as placed concrete it represents, is required.

- I. Air Content Test: Taken for each set of test cylinders taken, is required.
- H. One (1) Slump Test: Taken for each set of test cylinders taken is required.
- K. Test results will be reported by telephone to the General Contractor and Architect on same day tests are made. Written report with copies will follow to the Owner, Architect, and Landscape Architect. Email copies of laboratory test, evaluation reports for concrete materials and mix designs will be submitted.

3.09 CLEAN UP

During the contract and at intervals as directed by the Architect and as concrete work is completed, clear the site of gravel, concrete, appurtenances and debris. Leave the site in a clean, safe, well draining, neat condition.

SECTION 32 16 01

GRANITE CURB

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. The extent of granite curb is shown on the drawings.
- B. Provide materials, labor, equipment, and services required to accomplish related work in accordance with the drawings and specifications.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 32 12 01 - Asphalt Paving
- B. Section 32 13 01 - Site Concrete Work

1.03 SUBMITTALS: (See Section 31 12 01, 1.05)

- A. Provide material certificates showing granite curb source and that material meets product specification in Section 2.1 below.

1.04 JOB CONDITIONS

- A. Job conditions in Section 31 22 01 apply.
- B. Construction Review: Mark location in field for review by Architect prior to setting granite curb.

PART 2 - PRODUCTS

2.01 GRANITE CURB

- A. Shall be hard, durable, light grey in color and free from seams which would impair its strength. The curb shall be sawed top and split face. No drill marks shall appear on the exposed face. Minimum length shall be 2 ft.; maximum 8 ft. Curbs set to a radius of less than 100 ft. shall be cut to the curve required. Maximum length on curves shall be four feet.
- B. Provide project specific granite types:
 - 1. Vertical Curbs:
 - a. Standard: 5" x 16"
 - 2. Transition Curb
- C. Standard of quality: As manufactured by Geneva Granite Co. (315) 789-8142 or Architect approved equal.

2.02 WET CONCRETE SETTING BED

Shall be 4,000 psi as specified in Section 32 13 01, 2.03, 2.04.

2.03 GRANULAR BASE COURSE

As specified in Section 31 22 01, 2.01, B.

2.04 MORTAR

Shall be one part Portland cement, one part lime and three parts mason's sand by volume.

2.05 DRY MIX CONCRETE

Shall be Portland cement dry, mixed in the proportions of, one part Portland cement to three parts of concrete sand and six parts of coarse aggregate (passing 1-1/2" screen).

PART 3 - EXECUTION

3.01 SETTING CURB

- A. Curbing shall be set leveled on a 6-inch dry mix concrete setting bed foundation.
- B. Set granite to line and grade as shown on the plan. Provide continuous wet concrete backing both sides of curb. Joints shall be a minimum of 1/4" and shall be fully mortared from face to back of curb. Bevel corners to 45 degrees with a mitered joint.
- C. Set curbs to the line and grade given in a smooth curve or straight line. When curbing ends, it shall transition from a six (6") inch reveal to no reveal meeting finished grade.
- D. Curbing shall be set, backfilled, and compacted to 1/2 the height on the sidewalk face to prevent movement when backfilling is placed. Once the paving has been rolled, the remaining fill shall be placed and compacted to avoid future settlement of the walk.
- E. Pointing: The joints between curb stones shall be carefully filled with cement mortar and neatly pointed on the top and front exposed curb portions. Remove excess mortar and clean curb.
- F. Backfill curbing with wet concrete each side of the curb stone and all spaces under the curb shall be filled with concrete so that the entire unit is completely supported.

3.02 CLEAN UP

During the contract and at intervals as directed by the Architect and as granite curb installation is completed, clear the site of extraneous granite curb, concrete, gravel, asphalt and debris. Leave the site in a clean, safe, well draining, neat condition.

END OF SECTION

SECTION 321801

SYNTHETIC TURF

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. The extent of synthetic turf work is shown on the drawings. Note that the site contractor is responsible for providing and installing all materials and labor up to and including the finishing stone. The synthetic turf material (carpet and infill, and all items contained within this specification section), and associated installation shall be performed directly by the manufacturer off separate contract. Coordinate work.
- B. Synthetic turf work includes, but is not limited to, the following:
1. Drainage blanket surface inspection and approval
 2. 2 ½" pile height, dual blended, U.V. resistant polyethylene slit film and ridged monofilament fiber turf stitched into a primary and secondary backing.
 3. Tufted-in game lines and perimeter lines. Remaining required game markings and logos shall be permanently inlaid or painted as specified.
 4. Resilient three (3) layer infill system, consisting of a mixture of rubber granules and silica sand.
 5. Maintenance manual and onsite maintenance training
 6. G-max testing prior to Owner use of facility
 7. Twelve (12) year manufacturer's warranty
 8. Revisiting site for future G-max testing and infill adjustments
 9. Clean up
- C. Provide all labor, materials, tools and equipment necessary to install synthetic grass system as indicated on the plans and as specified.
- D. The installation of all new materials shall be performed in strict accordance with the manufacturer's installation instructions and in accordance with all approved shop drawings and submittals. The final product shall be a well-draining, even playing surface free of distortion, inconsistent infill levels, and other imperfections.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 31 22 01 - Site Earthwork
- B. Section 32 30 01 - Athletic Equipment and Furnishings
- C. Section 33 40 01 - Storm Drainage

1.03 REFERENCES

- A. FM P7825 - Approved Guide; Factory Mutual Research Corporation: current edition
- B. ASTM Standard Test Methods:
- D1577 - Standard Test Method for Linear Density of Textile Fiber
 - D5848 - Standard Test Method for Mass per Unit Area of Pile Yarn Floor Covering
 - D418 - Standard Test Method for Testing Pile Yarn Floor Covering Construction
 - D1335 - Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings

- D2256 - Standard Method of Test for Tensile Properties of Yarns by Single Strand Method
- D5034 - Standard Test Method of Breaking Strength and Elongation of Textile Fabrics (Grab Test)
- F1015 - Standard Test Method for Relative Abrasiveness of Synthetic Turf Playing Surfaces
- D4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity
- D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials
- F355A - Standard Test Method for Shock-Absorbing Properties of Play Surfaces
- F355E - Standard Test Method for Standard Test Method for Impact Attenuation of Playing Surface Systems, Other Protective Sport Systems, and Materials Used for Athletics, Recreation and Play
- F1936 - Standard Test Method of Shock-Absorbing Properties of North American Football Field Playing Systems as Measured in the Field
- F1551 - Standard Test Methods for Comprehensive Characterization of Synthetic Turf Playing Surfaces and Materials
- F2765 - Standard Specification for Total Lead Content in Synthetic Turf Fibers
- D5603- Standard Classification for Rubber Compounding Materials-Recycled Vulcanizate Particulate Rubber

- C. European Standard EN-71-3 - Safety of Toys Part 3: Migration of Certain Elements.
- D. National Federation of State High School Associations (NFHS) Rules and Regulations, latest edition.
- E. Synthetic Turf Council (STC): Suggested Guidelines for the Essential Elements of Synthetic Turf Systems, latest edition and Guidelines for Crumb Rubber Used in Synthetic Turf Fields, latest edition.
- F. American Sport Builders Association (ASBA): Sports Fields - A Construction and Maintenance Manual, latest edition.

1.04 SUBMITTALS (See Section 31 12 01, 1.05)

- A. Prior to the Architect approval of specified synthetic turf system, submit the following within seventy two (72) hours of bid opening, as requested:
 1. Submit two (2) 12" x 12" rag samples of proposed synthetic turf carpet and two (2) 12" x 12" boxed turf samples including infill representative of finished synthetic turf system.
 2. Certified copies of independent (third-party) laboratory reports on ASTM tests as follows:
 - a) Specific Gravity, ASTM D792
 - b) Tuft Bind, ASTM D1335
 - c) Grab Tear Strength, ASTM D1682 or D5034
 - d) Pile Height, Face or Pile Weight & Total Fabric Weight, ASTM D418 or D5848
 - e) Primary & Secondary Backing Weights, ASTM D418 and D5848
 - f) Flammability (Pill Test), ASTM D2859
 - g) Water Permeability, ASTM F1551
 - h) Yarn Breaking Strength, ASTM D2256

3. List of five (5) similar existing (in play) blended slit film/monofilament hybrid installations that have been installed in the Northeast Region of the United States including, Owner representative and telephone number(s).
 4. The Turf Contractor and Turf Manufacturer (if different from the company) shall provide a letter showing evidence that their turf system does not violate any other manufacturer's patents, patents allowed or patents pending.
 5. The Turf Contractor and Turf Manufacturer (if different from the company) shall provide three (3) copies of a current 3rd party, NON-CANCELABLE warranty insurance policy, supported by an A-Rated domestic insurance carrier, with a policy minimum claim limit of at least \$1,000,000. and annual aggregate limit of at least \$15,000,000. in order to fully cover the full replacement of the turf system in the event of total failure. Actual policy must be submitted for approval.
 6. Letter stating the products expected useful life under normal use conditions defined in the manufacturer's warranty.
 7. A letter and specifications sheet certifying that the products in this section meet or exceed specified requirements including certification from the turf manufacturer that hazardous materials such as but not limited to lead or lead chromate are not used in the manufacturing of the specified system.
- B. Submit the following prior to ordering of materials:
1. Shop Drawings (to scale) indicating:
 - a) Colored Field Layout and Field Marking plan for the specified NFHS sports.
 - b) Colored Logo / Lettering Designs and Dimensions.
 - c) Roll/Seaming Layout
 - d) Methods of attachment, field openings and perimeter conditions.
 2. Material Certificates: Provide material certificates for each material used in the turf system from the turf manufacturer that will be used for this project including, but not limited to, type and composition of fiber(s), primary and secondary backing, and urethane(s).
 3. Samples: Submit two (2) 12" x 12" samples of each turf color specified to be used for tufted and inlaid lines / logos. Tufted and Inlaid turf shall match the specified synthetic turf system. Provide two (2) bagged samples each of rubber and sand infill material.
 4. Supplier Certification that crumb rubber infill (CRI) being used for the turf system is from only used, whole, vulcanized automobile, SUV, or truck tires and produced in compliance with North American tire manufacturing specifications.

Include documentation of compliance with EN-71-3 Standard for Children's Toys as indicated in Part 2, Paragraph 2.01, D. Include documentation of compliance with ASTM D5603-01 as indicated in Paragraph 7.3.2.
 5. The Turf Contractor and Turf Manufacturer (if different from the company) shall provide a sample warranty that meet requirements in 1.08 of this section.
 6. Submit copies of proposed installation foreman's resume. Installation crew must meet or exceed all requirements outlined in Section 1.08.

- C. Provide crumb rubber infill (CRI) order certification noting type and origin of raw material, production facility, production method, fiber content (%), and CRI sieve and gradation analysis. All supersacks shall provide traceability to date of production and origin of processing.
- D. No reclaimed infill, sand or rubber, from other synthetic turf field installations are permitted.
- E. Prior to Final Acceptance, the Turf Contractor shall submit to the Architect / Owner:
 - 1. Independent G-Max test results and a letter indicating compliance with future G-Max testing as specified in 1.05 of this Section.
 - 2. Independent HIC test results and a letter indicating compliance with future HIC testing as specified in 1.05 of this Section.
 - 3. Three (3) copies of Maintenance Manuals, which will include all necessary instructions for the proper care and preventative maintenance of the synthetic turf system, including painting and markings.
 - 4. Recommended Maintenance schedule provided by vendor for first three (3) years after installation.
 - 5. Synthetic Turf Warranty: Submit twelve (12) year fully executed Manufacturer Warranty and ensure that forms have been completed in Owner's name and registered with Manufacturer and Insurance carrier. This includes the Certificate of Insurance from the Insurance Carrier confirming that the third-party insurance policy, non-cancelable and pre-paid is in effect covering this installation and is in force.

1.05 QUALITY ASSURANCE

- A. Turf Manufacturer Qualifications: Company specializing in manufacturing of products specified in this section. The Turf Contractor and/or the Turf Manufacturer:
 - 1. Must be experienced in the manufacture and installation of this specific type of synthetic infill blended fiber grass system including fibers, backing, backing coating, adhesives, infills and installation methods at exterior sites over the last three (3) years.
 - 2. Must have a minimum of five (5) exterior fields installed with same slit film/monofilament product specified still in use and fields should be a minimum of 65,000 square feet in size.
- B. Turf Installer Qualifications: Company specializing in performing the installation work of this section.
 - 1. The Turf Contractor must have been in business (under its' current name and Ownership) for at least the past five (5) years and must have a minimum of twenty five (25) athletic fields still in use in the United States for a minimum of the last five (5) years.
 - 2. The designated Supervisory Personnel on the project must be factory certified, in writing by the Turf Manufacturer, as competent in the installation of this specified

- blended slit film/monofilament material, including sewing seams and proper installation of the infill mixture.
3. The Factory Certified Supervisory Personnel shall be on site to certify the turf installation and Warranty compliance.
 4. The Turf Contractor must provide competent workmen skilled in this specific type of synthetic grass installation. The installation crew / technicians shall have experience of at least three (3) fields in play with the same monofilament fiber system being used.
- C. Prior to the beginning of the synthetic turf installation:
1. The installer of the synthetic turf shall inspect the stone drainage sub-base for tolerance to grade.
 2. String line the entire field every five (5') feet to identify high and low spots. Assist the stone drainage blanket installer with correcting any deficiencies in a proper and timely manner.
 3. The turf installer will review and confirm Owner provided project test results for stone drainage base compaction, planarity and permeability to be in compliance with project specifications as it relates to the synthetic turf warranty.
 4. The turf installer will accept the stone drainage sub-base in writing and supply a "Certificate of Base Acceptance" for the Architects approval before turf installation can begin.
- D. Shock Attenuation Evaluation (G-Max Testing):
1. Near the completion of the turf, hire a third party, independent testing agency to perform ten (10) in place G max tests in compliance with ASTM F1936 and F355A, in locations as directed by the Architect. If any test results exceeds **125**, modify the infill material ratios as necessary to achieve satisfactory results. Perform additional testing to verify the results as directed by the Architect.
 2. Guarantee / Warranty: During the twelve (12) year guarantee period, the G max rating shall remain less than **165**. Hire a third party, independent testing agency to perform ten (10) in place G max tests, in locations as directed by the Owner, during the first, third, fifth, seventh, ninth and eleventh years. If any test results meet or exceed **165**, modify the infill material ratios as necessary to achieve satisfactory results. Perform additional testing to verify the results as directed by the Owner. If the G max rating exceeds **165** after three (3) attempts to repair the high rating, the Turf Contractor and Turf Manufacturer shall fully replace the synthetic turf field within ninety (90) calendar days at no cost to the Owner.
- E. Materials Quality:
1. All components and their installation method shall be designed and manufactured for use on outdoor athletic fields used for full contact football. The materials as hereinafter specified, should be able to withstand full climatic exposure in the specific location of the field, be resistant to insect infestation, rot, fungus and mildew; it shall also withstand ultra-violet light and heat degradation, and shall have the basic non clogging characteristic of vertical flow through drainage allowing free movement of surface run-off vertically through the turf where such water may flow through the stone blanket and into the field perimeter drainage system.

2. The adhesive bonding and sewn seams of all system components shall provide a permanent, tight, secure, and hazard free athletic playing surface. All inlaid lines / markings / logos and sewn seams shall remain in place throughout the duration of the warranty period.
3. The installed synthetic turf system (turf and infill), for the life of the product, shall drain through a rate of not less than 20 inches +/- per hour.
4. Crumb Rubber Infill:
 - a. Shall not contain more than 0.01% by weight liberated fiber in accordance with the Synthetic Turf Council.
 - b. Shall not contain more than 0.1% by weight within a 100-gram sample of metal content in accordance with ASTM D5603-01.
 - c. Provide testing of one (1) supersacks of CRI for iron content per load (or 44 bags), in accordance with ASTM D5603-01, 7.3.2. This would average 5 bags per field.
 - d. Crumb rubber infill material that does not meet the standards for ASTM D5603-01 and EN-71-3 shall be removed and replaced at no additional cost to the Owner.
5. Material that does not meet the standards shall be removed and replaced at no additional cost to the Owner.

1.06 PRE-INSTALLATION MEETING

- A. Convene One (1) Week after receipt of Submittals identified in 1.04, A. above;
 1. An interview shall take place at a time and date to be determined by the Architect at the District Office of Lowville Academy and CSD. Present at this meeting shall be the Landscape Architect, Owner's Representative(s), the Project Manager and Site Superintendent for the Prime Contractor and the Project Manager and Project Foreman for the Turf Installer. The purpose of this meeting will be to review turf product and installation means and methods, to interview and ascertain the experience and competence of the Turf Installer, as well as, the onsite Project Foreman for this project and to review the project schedule. The basis of choosing this particular product shall be in part due to the results of this interview process. Contractor shall submit all required submittals before this meeting as described in 1.4, A. above.
- B. Convene Two (2) Weeks Prior to Stone Drainage Blanket Completion:
 1. A second meeting shall take place at a time and date to be determined by the Architect at the District Office of Lowville Academy and CSD. Present at this meeting shall be the Landscape Architect, Owner's Representative(s), and the Project Manager for the Prime Contractor. The purpose of this meeting shall be to review and confirm schedule. (with particular attention on the turf installation) and to confirm that the turf product has been ordered by way of notarized copies of the original confirmed Purchase Order and guaranteed delivery date.

1.07 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver products to project site in wrapped, neat, secure condition. Provide means to unload products from delivery trucks.

- B. Store products under cover and elevated above grade. Turf and turf material left on bare ground is not acceptable to be used and may be rejected by the Architect.
- C. Protect all products and installation area from vandalism, theft, other construction, premature use, etc. until Owner acceptance and Architect sign off.

1.08 WARRANTY

- A. The warranty coverage shall not be prorated nor place limits on the amount of the field's annual usage.
- B. The Turf Contractor and/ or Turf Manufacturer shall provide a twelve (12) year Warranty and supported by a prepaid third party insured eight (8) year warranty, from an A-rated domestic insurance carrier, which warrants the usability and playability of the artificial turf system for its intended uses. Letters of credit are not acceptable.
- C. The Turf Contractor and/or Turf Manufacturer must verify that their onsite representative has inspected the installation and that the work conforms to the Turf Manufacturer's requirements.
- D. The Warranty shall support that all designs, game markings, and layouts conform to all currently applicable NFHS rules and regulations, or league specific requirements, depending on application.
- E. The Warranty must have the following minimum characteristics:
 - 1. Provide full coverage for a minimum of twelve (12) years from the date of Substantial Completion.
 - 2. The turf fabric shall not lose more than an average 2% per year and not be limited to the amount of annual usage.
 - 3. Shall guarantee the availability of replacement material for the synthetic turf system installed for the life of the warranty, including items that are no longer serviceable to maintain a serviceable and playable surface.
 - 4. The warranty shall be all encompassing of the turf system including, but not limited to, the fibers, backing, adhesives, infill, tape and logos.
 - 5. The Warranty shall include general wear including lacrosse goal crease(s) and damage caused from UV degradation.
 - 6. The Warranty shall specifically exclude vandalism, and acts of God beyond the control of the Owner or the manufacturer.
 - 7. Covers defects in the installation and workmanship, and further warrant that the installation was done in accordance with both the Manufactures' recommendations and any written directives of the Manufacturer's onsite representative.
 - 8. Shall NOT be limited to just the repair or replacement of affected areas. Shall include all necessary materials, labor, transportation, removals, and disposal costs to complete repairs or replacement.

9. The synthetic grass turf must maintain an ASTM F355A and ASTM F1936 G-max of between 125 and 165 for the life of the Warranty. Refer to 1.05, D. of this section.
10. The synthetic grass turf must maintain an ASTM F355E of between 700 and 1000 for the life of the Warranty. Refer to 1.05. of this section.
11. Any repairs or service to the field requested by the Owner or the Owner's representative shall be addressed within seven (7) days from the date of written notification.

1.09 MAINTENANCE SERVICE

- A. The Turf Contractor will train the Owner's facility maintenance staff in the use of the specified maintenance attachments and equipment to routinely groom, sweep and plow the field.
- B. The Turf Contractor will provide the Owner's facility maintenance staff with a recommended maintenance schedule specific for the intended level of use, etc.

PART 2 - PRODUCTS

2.01 SYNTHETIC TURF SYSTEM

- A. The installed synthetic turf system shall have the following physical properties:

Property	Specification	ASTM
Product Weight:	68 oz/sy (+/- 2 oz)	D418/D5848
Pile Yarn Weight:	47 oz/sy	D418/D5848
Fiber Denier	12,000 (mono); 5,000 (slit)	D1577
Yarn Thickness:	360 microns (mono); 130 microns (slit)	D3218
Pile Height:	2 ½" nominal	D418/D5848
Avg. Tuft Bind:	9+ lbs. (with infill)	D1335
Primary Backing:	7 oz/sy	D418/D5848
Secondary Backing:	16 oz/sy (urethane)	D418/D5848
Avg. Grab Tear (length)	>200 lbs./force	D5034
Avg. Grab Tear (width)	>300 lbs./force	D5034
Abrasiveness Index	<25	F1015
Permeability	>40 inches/hour	DIN 18-035-6
Pill Flammability	Pass	D2859
G Max (Impact)	< 125 at install, < 165 over life of field	F355A/ F1936
HIC (Impact)	< 700 at install, < 1000 over life of field	F355E
Tufting Gauge	3/4"	
Stitch Rate	3 stitches per 1"	
Field Color	Academy Field: Field Turf Green with white football coaches boxes, Brown baseball and softball infields, Brown base coach boxes, Brown on-deck circles. Logos as shown on plans and details. Bostwick Field: Field Turf Green, Summer Green – alternating every 10 yards with White football coaches boxes, Red border between soccer lines and edge of turf, Red endzones. Logos as shown on plans and details.	
Roll Width / Length	15'wide and up to 220' long	
Infill	3 lbs/sf cryogenic ground rubber / 6.2 lbs/sf sand	
Drainage	porous non-woven fabric backing	

- B. Turf Carpet: shall consist of 100% polyethylene U.V. stabilized slit film fiber (Classic HD) and monofilament fiber (Revolution) extruded by spinneret and tufted into a primary backing (double layered polypropylene fabric treated with U.V. inhibitors) with a secondary backing with an application consisting of a minimum of 16 ounces of heat activated urethane per square yard to permanently lock the fiber tufts in place (Sure Lock Coating System).
1. The Carpet shall be furnished in 15' wide rolls with four (4") inch white, football 5-yard lines tufted into each roll, when applicable. The perimeter white line shall also be tufted into the individual sideline rolls, when applicable. The rolls shall be of sufficient length to go from sideline to sideline without splicing. Head seams, between the sidelines, will not be acceptable. All seams will be sewn (glued seams are NOT acceptable) and thread for sewing shall be as recommended by the Turf Manufacturer.
 2. The fiber shall be low friction, UV-resistant fiber measuring not less than 2 ½" high. The same fiber from the above listed projects (Section 1.04, B.) must be used on this project.
 3. All colored inlaid lines, sport markings, numbers, and logos shall be made of the same exact monofilament fiber material as specified for the field carpet and shall be cut in and glued or "inlaid" as recommended by the Turf Manufacturer.
- C. Field Markings: All markings to be installed in accordance with the Owner / Architect approved shop drawings, NFHS, and ASBA standards.
1. Tufted Lines: field lines to be tufted into the turf:
 - a. Football: Color shall be white.
 - 1) Side lines
 - 2) End lines
 - 3) 5-yd lines
 - 4) Goal lines
 2. Inlaid Lines: field lines to be inlaid into the turf:
 - a. Football: Color shall be white, except where noted.
 - 1) 10-yd numbers and arrows – White with Red shadow
 - 2) 1-yd hash markings
 - 3) Inbound hash markings
 - 4) Extra point lines
 - 5) Kick off markings
 - 6) Limit lines and Coaches Box/Coaches Box area
 - b. Soccer: All lines shall be inlaid Yellow or approved by owner.
 - c. Men's Lacrosse: All lines shall be inlaid Black or approved by owner.
 - d. Women's Lacrosse: All lines shall be inlaid Gray or approved by owner.
 - e. Women's Field Hockey: All lines shall be inlaid Orange or approved by owner.
 - f. Logos, Text, and Graphics: will be inlaid according to color and artwork, submitted by the Owner / Architect to the Turf Contractor.

- D. Resilient infill three (3) layer system: The resilient infill materials shall be approved by the Manufacturer. The infill shall consist of a resilient layered granular system of approximately 3 lbs. per square foot of cryogenically hammer-milled SBR crumb rubber and 6.2 lbs. per square foot of selected and graded dust free silica sand engineered to provide the look, feel, footing, and shock absorption of a natural grass field in ideal conditions.
1. Cryogenically ground SBR Crumb Rubber: Granules shall contain minimal dust or contaminants and shall be derived from the cryogenically hammer milled processing form of recycled tires. Color shall be substantially black and shall meet the 10 – 20, 8 – 16 or 8 – 14 mesh size designation.
 - a. The clean, uniformly sized particles shall be consistent in shape and particle size distribution.
 - b. The particles shall resist abrasion in high traffic and excessive wear applications and provide stability to artificial sports turf applications.
 - c. The particles shall be processed and sized under rigid specifications and Manufacturers' statistical and quality control assurance program.
 - d. Particles shall be structurally pure and consistently uniform in size distribution for predictable performance.
 2. SBR Crumb Rubber Certification: The Turf Contractor / Turf Manufacturer shall provide in writing that they maintain an ongoing Quality Control program meeting all the standards of the STC Guidelines for CRI Used in Synthetic Turf Fields and capable of meeting all specifications described herein.
 - a. Turf Contractor shall supply the Architect with a copy of the Crumb Rubber Infill (CRI) Shipment / Order Certification that includes, type and origin of raw material (certify that it comes from tires), production facility, production method, fiber content (%), and (CRI) sieve / gradation analysis.
 - b. The SBR rubber infill provided for this project shall comply with the Synthetic Turf Council's recommended testing guidelines for infill based on the EN 71-3 standard for children's toys or come from a source that maintains an active Environmental Labs (UL) Environmental Claim Validation Summary showing that the rubber produced actively meets the EN 71 standard and CPSIA standard for lead. Provide written document stipulating the above.
 3. Sand Particulate: The sand provided as a component of the infill mixture shall be rounded so as to minimize abrasion to the athlete and synthetic grass fibers. Supplied from either Unimin or US Silica or Architect approved equal.
- E. Inlaying Materials:
1. Adhesive for inlaying lines and markings shall be a two-component fast set urethane adhesive obtained from a single manufacturer and be equivalent to Ultrabond Turf PU 2K as manufactured by Mapei Corporation (800)-992-6273, or one-part moisture-cured polyurethane obtained from a single manufacturer and be equivalent to 34-G as manufactured by Synthetic Surfaces, Inc. (908)-233-6803 or Architect approved equal.
 2. Seaming Tape: Tape for securing inlaid lines shall be high quality tape made with a minimum roll width of twelve inches (12”).
- F. Alternating Field Panels: Field color shall be dual color alternating panels with blended fibers of Field Green and Summer Green. Other markings shall be as noted in 2.01.

- G. Overplay Area: Field color in soccer overplay areas to be Field (Dark) Green made of the same fibers as main carpet. Other marking colors shall be as noted in 2.01.
- H. Standard of Quality shall be: **Field Turf Vertex Prime (FTVTP-1)** synthetic turf system as manufactured by:

FieldTurf International, Inc.
Dalton, GA 30721
www.fieldturf.com

Contact: Chris White, (607)-729-8500

Synthetic turf system shall be provided and installed by Owner under contract purchasing. Synthetic turf system specification provided for reference and coordination purposes.

2.02 HIGH TRAFFIC AREA REPLACEMENT

- A. The synthetic turf manufacturer shall be responsible to remove and replace the high traffic lacrosse goal (men's and women's) areas in years 4 and 8 of the 12-year warranty period.
- B. Color shall be Field or Summer Green to match the main field. Contractor to confirm prior to installation.

PART 3 - EXECUTION

3.01 GENERAL

- A. The installation shall be performed in full compliance with approved Shop Drawings and Submittals.
- B. Only trained technicians, skilled in the installation of outdoor athletic caliber synthetic turf systems working under the direct supervision of the Factory Certified Installation Supervisors, shall undertake any cutting, sewing, gluing, top-dressing or brushing operations.
- C. The designated Supervisory personnel on the project must be certified, in writing by the turf manufacturer, as competent in the installation of this material, including sewing seams and proper installation of the infill mixture.
- D. All designs, markings, layouts, and materials shall conform to all currently applicable NFHS rules and/or other rules or standard that may apply to this type of synthetic grass installation. All designs, markings and layouts must first be approved by the Architect and Owner in the form of an approved shop drawings. All markings will be installed in full compliance with those drawings.

3.02 EXAMINATION

- A. Verify that all stone drainage sub-base leveling is complete prior to installation.
- B. The surface to receive the synthetic turf shall be inspected by the Turf Contractor, and prior to the beginning of installation, the Turf Installer must accept the sub-base planarity in writing. The surface must be perfectly clean as installation commences and planarity shall be maintained to a surface tolerance that does not exceed 0"-1/4" over 10 feet and 0"-1/4" from design grade throughout the installation process by the Turf Contractor.

3.03 TURF INSTALLATION

- A. Install in accordance with Manufacturer's instructions. The Turf Contractor shall strictly adhere to the installation procedures outlined under this section. Any variance from these requirements must be accepted in writing, by the Manufacturer's onsite representative, and submitted to the Architect/Owner, verifying that the changes do not in any way affect the warranty or performance of the system. Infill materials shall be approved by the Manufacturer and installed in accordance with the Manufacturer's standard procedures.
- B. The carpet rolls are to be installed directly over the properly prepared stone drainage blanket or resilient pad, if applicable. Rolls shall be laid out flat a minimum of four (4) hours prior to starting seaming procedures and allowed to relax / expand. Extreme care should be taken to avoid disturbing the stone blanket or pad, both in regard to compaction and planarity. Provide a 2-5 ton static roller onsite to repair and properly stabilize any disturbed areas of the stone blanket.
- C. The full width rolls shall be laid out across the field. Turf shall be sufficient length to permit full cross-field installation from sideline to sideline. No "head" or cross seams will be allowed in the main playing area between sidelines. Utilizing standard state of the art sewing procedures each roll shall be attached to the next. When all of the rolls of the playing surface have been installed, the sideline areas shall be installed at right angles to the playing field turf.
- D. All seams shall be sewn using double bagger stitches and polyester thread (per the manufacturer's standard sewing procedures). Seams shall be flat, tight and permanent with no separation or fraying, for the life of the carpet.
- E. Infill materials shall be applied in numerous thin lifts. The turf shall be brushed as the mixture is applied. The infill material shall be installed to a depth determined by the Manufacturer or 1.75 inches within the fiber matrix. The mix shall be uniform and an even thickness to assure proper playing characteristics.
- F. All equipment used for spreading of infill shall be fitted with a magnetic tow bar, so that as CRI is being installed, metallic impurities will be collected. If spreading equipment cannot be fitted with a magnetic tow bar, the contractor shall follow each pass of the spreading machine with a magnetic tow bar equipped on separate equipment to collect metallic impurities as the infill is being installed.
- G. The infill materials shall be installed to fill the voids between the fibers and allow the fibers to remain vertical. Specifically formulated rubber and sand infill shall be installed in accordance with manufactures system recommendations.
- H. Synthetic turf shall be attached to the perimeter edge detail in accordance with the Manufacturer's standard procedures and as detailed.
- I. Inlaid markings that are not tufted into the system shall be cut in and glued in accordance with synthetic turf contractors approved seaming methods for "inlaid" game markings.
- J. Prior to field acceptance, the turf shall be groomed by means of a nylon rotary brush to provide the look, feel and safety of optimally maintained natural grass, including subtle undulation normally associated with natural grass athletic fields as reviewed and approved by the Architect. The field shall have a magnetic tow bar run over the final surface one last time prior to the final grooming.

- K. The Turf Contractor shall leave the Owner two (2) full spare bags of crumb rubber/sand blend to use in topdressing the fields. Leave in a location as approved by the Owner.

3.04 CLEAN UP

- A. Contractor shall provide the labor, supplies and equipment as necessary for final cleaning of surfaces and installed items to the satisfaction of the Architect / Owner.
- B. All usable remnants of new material shall be neatly rolled up and turned over to the Owner at a place and area designated by the Owner.
- C. During the contract and at intervals as directed by the Architect and as synthetic turf installation is completed, clear the site of all extraneous materials, rubbish, or debris and leave the site in a clean, safe, well draining, neat condition.
- D. Surfaces, recesses, enclosures, etc., shall be cleaned as necessary to leave the work area in a clean, immaculate condition ready for immediate occupancy and use by the Owner.

END OF SECTION

SECTION 32 18 20

RESILIENT TRACK SURFACE

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. The extent of resilient track and field event surfacing is shown on the drawings and as indicated in this specification.
- B. Resilient track surfacing system work includes, but is not limited to, the following:
 - 1. 400 meter track layout conforming to NFHS planarity standards
 - 2. Medium duty asphalt pavement inspection and acceptance
 - 3. Resilient track and field event surfacing
 - 4. Line striping, shape and event markings
 - 5. Logo, text and graphics
 - 6. Warranty: Five (5) years.
- C. The resilient track surface shall be a Polyurethane bound permeable running track surface. The final product shall be a track surface free of distortion, inconsistent textures and other imperfections.
- D. The Contractor shall provide all materials, labor, equipment, and services required to accomplish all related work in accordance with the drawings and specifications. All quantities and dimensions shall be field verified by the Contractor.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 32 12 01 - Asphalt Paving

1.03 REFERENCES

- A. Codes and standards follow the current guidelines set forth by the National Federation of State High School Associations (NFHS), National Collegiate Athletic Association (NCAA), American Sports Builders Association (ASBA), International Amateur Athletic Foundation (IAAF), along with the current materials testing guidelines as published by the American Society for Testing and Materials (ASTM).
- B. Performance Standards: The new resilient track surfacing system shall exhibit the following minimum performance standards as required by the IAAF:
 - 1. Thickness: 13 mm (½")
 - 2. Force Reduction: 35 to 50%
 - 3. Vertical Deformation: 0.6 to 2.5mm
 - 4. Friction: ≥ 0.5(47 TRRL Scale)
 - 5. Tensile Strength: ≥ 0.4 MPa
 - 6. Elongation at Break: ≥ 40%
 - 7. Color: Black

1.04 SUBMITTALS: (See Section 31 12 01, 1.05)

- A. Standard printed specifications of the resilient track surfacing system to be installed on this project.

- B. An affidavit attesting that the resilient track surfacing material to be installed meets the requirements defined by the manufacturers currently published specifications and any modifications outlined in those technical specifications. (Material Certification)
- C. A resilient track surfacing system sample, 4" x 6" in size, of the same resilient track surfacing system to be installed on this project.
- D. All submittals required in Quality Assurance of this specification, and a list of ten (10) completed facilities within the last two (2) years of the exact resilient track surfacing. The reference list must be under the current contractor name and include the installing supervisor.
- E. A current IAAF test report proving the product to be installed meets the current IAAF Performance Standards for Synthetic Surfaced Athletic Tracks (Outdoor) with the documented certified test results.
- F. Line Marking Paint: MPD
- G. Shop drawings provided by the Track Computing Statistician (TCS) indicating all event markings, lines, locations, color, governing rules (NFHS) and races to be accommodated. This drawing shall also verify 400 meter dimensions of the track layout prior to the resilient surface installation.
- H. Written correspondence from the resilient track surfacing Contractor accepting the planarity of all asphalt receiving track surfacing.

1.05 JOB CONDITIONS

- A. All job conditions in Section 32 12 01 apply.
- B. The resilient surfacing contractor shall coordinate the work specified with an authorized and appointed representative of the Owner so as to perform the work during a period and in a manner acceptable to the Owner. A manufacturer's representative shall be on site during the surface and marking installation to make "on the spot" recommendations to meet field conditions.
- C. Installation shall not take place if adjacent or concurrent construction generates excessive dust, abrasives or any other byproduct that, in the opinion of the resilient track contractor, would be harmful to the resilient track surfacing material, until completion of such works.
- D. Apply surfacing and markings in a warm, dry atmosphere at ranges as recommended by the manufacturer. Work must be completed prior to October 15 for proper curing. Do not install track surface during or within 12 hours after rainfall or if rain is pending. Protect from freezing and other construction. If, in the opinion of the installer of the resilient track material, the weather and/or climate conditions are detrimental to the proper installation of the surfacing materials, work shall be delayed until conditions are acceptable. Installation shall be executed only in dry conditions.
- E. Contractor to provide temporary barriers to prevent entry to construction area and to protect adjacent properties and Owner's site elements from damage during resilient track surfacing installation.
- F. Construction Review: Notify the Architect at the following phases:
 - 1. When the 400 meter track is staked out.

2. When the 400 meter track is ready to receive the resilient track surfacing.
3. When the 400 meter track is ready to receive the markings.

1.06 QUALITY ASSURANCE

- A. Measurements: Shall be made by an experienced NYS Licensed Land Surveyor who is approved by the Architect and must certify that "all points shown on the 'as built drawing' were accurately measured and properly designated on the track in accordance with current governing rules and accepted tolerances and Owners desires" with license stamp, name, address and date. Submit name(s) for approval.
- B. Resilient Track Contractor Qualifications:
 1. The Contractors must be an approved installer by the product manufacturer.
 2. The Contractor shall be able to furnish evidence that they have been in business for a period of not less than three (3) years, under the present name, and if required, furnish financial statements for each of the past three (3) years.
 3. The Contractor must have installed a minimum of ten (10) outdoor track facilities in the last two (2) years using the exact, IAAF certified, resilient track surface, as specified herein by the contractor bidding this project. Provide a reference list with contract names and phone numbers. The Architect will qualify the bidding firm and applier based on phone contact with the above information.
 4. The Contractor is required to provide documentation that shows the selected specified and installed product meets current IAAF performance Standards for Synthetic Surfaced Athletics Tracks (Outdoor) and is certified in terms of the IAAF certification system as updated to present day.
- C. Manufacturer's Qualifications:
 1. The manufacturer must have an IAAF certified track surfacing product meeting the performance standards in this specification, 1.03, B.
 2. The manufacture's must be ISO 9001 and ISO 14001 Certified
 3. The manufacturer must have a minimum of ten (10) years experience manufacturing polyurethane for resilient track surfaces
- D. Calculations: For all dimensions to properly mark the track will be done by an experienced and qualified Track Computing Statistician (TCS) with at least three (3) years proven experience approved by the Architect. Calculations and dimensions shall be guaranteed "to be accurate and correct in accordance with the current governing rules and regulations and the Owners' desires" by the TCS. All dimensions and angles calculated from one of the four PC lines shall appear on an "as built" drawing with name, address and date of the guarantor. Submit name(s) for approval.
- E. Event Markings and Lines: Shall be done by experienced qualified person with at least three (3) years proven experience, approved by the Architect, who must guarantee "all markings were made using the designated points, in accordance with current governing rules and Owners' desires", with his name, address and date. Submit name(s) for approval.

1.07 WARRANTY

- A. Resilient track surfacing shall be fully guaranteed against faulty workmanship and material failure for a period of five (5) years from the date of acceptance. The warranty coverage shall not be prorated nor limited by the amount of usage. Track striping and marking shall be warranted for a period of two (2) years. Any defects appearing during these periods shall be promptly corrected within thirty (30) days of written notification at no additional cost to the Owner.
- B. Resilient surfacing material found to be defective as a result of faulty workmanship and/or material failure shall be replaced or repaired at no charge, upon written authorization within the warranty period.
- C. The warranty excludes damage or defects caused by vandalism, abuse, or acts of God.

PART 2 - PRODUCTS

2.01 MEDIUM DUTY ASPHALT PAVEMENT

- A. Shall be as described in Section 32 12 01.
- B. For NFHS certification the following criteria must be followed. The track surface, i.e. asphalt substrate, shall not vary from planned cross slope by more than $\pm 0.2\%$, with a maximum lateral slope outside to inside of 1%, and a maximum slope of 0.1% in any running direction. The finish asphalt shall not vary under a 10' straight edge more than 1/8".

2.02 SURFACING

- A. Primers: Standard of quality shall be Qualipur Polyurethane 1030 or Architect approved equal, blended with a suitable thinner formulated to be compatible with the paved-in-place EPDM granules and Qualipur track surfacing material.
- B. Black SBR Granules: The rubber granules for the base mat shall be recycled SBR rubber, processed and chopped to 1-3.5 mm size containing less than 1% dust. SBR is to be dried to no less than 2.5% moisture and sealed in bags.
- C. Polyurethane Binder: Binder for the black mat shall be bound by a moisture-cured liquid Qualipur polyurethane. The binder shall be black in color and contain no asphaltic emulsions or epoxies. The binder must be specifically formulated for compatibility with SBR rubber crumb.
- D. One Component Structural Spray: A pigmented, one component, aliphatic structural spray coating mixed with spray rubber containing no harmful chemicals or free isocyanates.
- E. One Component Structural Respray: Refer to one component structural spray above.]
- F. Line Marking Paint: All line and event markings shall be applied in one (1) coat by experienced personnel utilizing a single component, moisture cured, aliphatic polyurethane paint compatible with the resilient track surfacing specified.
- G. Standard of quality shall be **Sputan BS Resilient Track Surfacing** as supplied by Nagle Athletic Surfaces, Inc. in East Syracuse, NY (315) 622-1313 or Architect approved equal.

PART 3 - EXECUTION

3.01 PREPARATION

- A. NYS Licensed Land Surveyor shall verify dimensions shown on plan. After TCS has computed calculations for a 400-meter track (400 meter plus 1/4 inch total length), NYS Licensed Land Surveyor shall stake out track. Submit calculations to the Architect for approval as indicated in this specification.
- B. Locate and establish radius points along with all necessary control points using a transit or Theodolite capable of reading direct to 20 degrees.
- C. The paving Contractor shall prepare subgrade and place asphalt pavement to create a verifiable 400-meter track meeting NFHS, NCAA, and ASBA current standards.
- D. Surface Inspection: Prior to the application of the resilient track surface, inspect the asphaltic base for conformity to planarity requirements as noted in Section 321201. The surface shall not deviate from the specified grade and planarity more than 1/8 inch in ten (10') feet measured in any direction. All areas not in conformance with the above requirements will be removed and replaced by the paving Contractor, with compatible materials as approved by the track manufacturer and allowed to cure prior to application of resilient track surface, at no additional cost to the Owner and no impact to the project schedule.
- E. Curing: Before application of the resilient surface can begin, the asphalt and shot blasted / sealed concrete should be cured for at least fourteen (14) days. It shall be responsibility of the resilient track surfacing Contractor to determine if the concrete and asphalt have cured sufficiently prior to installing resilient surfacing.
- F. Cleaning: The area to be surfaced shall be clean and free of any loose or foreign particles (dirt, oil, etc.) prior to commencement of the work by use of a power blower and/or high pressure washer. Any oil spills (hydraulic, diesel, motor oil, etc.) must be completely removed, either by chipping out or removing and replacing with new, keyed in asphalt.
- G. Mask out and protect from overspray adjacent areas including, but not limited to, asphalt, fencing, bleachers, vehicles, buildings, synthetic turf, and grass to avoid overspray problems. Contractor is responsible for any costs for cleaning related to any possible overspray.
- H. It shall be the responsibility of the Site Contractor to determine if the asphalt surface meets all design specifications, i.e. cross slopes, planarity and specific project criteria. After all the above conditions are met, the resilient track surfacing Contractor must, in writing, accept the planarity of the asphalt receiving track surfacing before work can commence.
- I. Any concrete surface to be covered with resilient track surfacing shall be shot blasted and sealed as recommended by the manufacturer.

3.02 RESILIENT SURFACE

- A. Priming: Apply polyurethane primer to the entire asphalt surface at a rate of not less than 0.3 lbs per square yard. Allow a minimum of thirty (30) minutes curing time before the application of the base mat material. Only those area which can be installed the same day should be primed.

- B. Mixture Composition: Job mix formulas shall be as follows:
- | | |
|----------------------------|-------------|
| SBR Rubber Granules | 77 % to 82% |
| Polyurethane Binding Agent | 18% to 23% |
- C. Black Mat (Base Course):
1. Blend the black rubber granules and polyurethane binding agent together in a suitable mixer for a period of 2 to 3 minutes. The blended materials are then spread onto the asphalt base by means of a mechanical tandem in a single, 13mm layer. The tandem leveler shall have a heated oscillating screed bar to obtain both smoothness and compaction. The heated screed bar normally works at a temperature of 158 to 176 degrees F. All joint work shall be trowelled flush with the adjacent surface. Prime all joints edges which have cured.
 2. The laying procedure shall be bay-to-bay and limiting the length of the passes so as not to have any cold (cured) joints between the bays. At the beginning of each new day's work, the traverse joint from the previous day's work shall be tack coated to ensure a proper bond. Small irregularities remaining in the surface after the tandem leveler has passed may be removed using a light polyethylene or teflon roller or hand trowelled.
 3. The base mat shall be blended in a clean, dry mixing machine specifically designed with automatic proportioning controls to produce exact proportions of the polyurethane. No hand mixing or spray coating is acceptable. Apply with a laser controlled mechanical tandem leveler.
 4. The surface hardens through the reaction of the binding agent with humidity. The speed of the reaction depends on temperature and relative humidity. No traffic is permitted until the surface has adequately hardened.
- D. Structural Spray Finish: Mix the structural spray and spray rubber until thoroughly coated. The mixture should be sprayed in two separate applications. Apply the second coat, in an opposite direction as to the first. The minimum application rate is 3.6 lbs/sy for the structural spray and EPDM spray rubber. Apply manufacturers specified amounts to achieve proper coverage.

3.03 EVENT MARKINGS AND LINE STRIPING

- A. Line Striping: All line and event markings shall be applied by experienced personnel utilizing polyurethane based paint compatible with the resilient track surfacing. All marking dimensions will be certified in accordance with the specifications issued by the appropriate sanctioning or governing body such as NFHS.
- B. Coordinate a meeting with the Architect and Owner's Athletic Director to layout options and events including, but not limited to, governing rules, location of finish line, races to be accommodated, color code, and design of markings/logos/text. Prepare a written list and graphic layout plan of all events and markings agreed to by the Architect and Owner's Athletic Director to distribute to all parties. A preliminary List of Events follows:

TRACK EVENTS

1. 100 meters (both directions on straightaway)
1. 200 meters
2. 55 meter hurdles
3. 100 meter hurdles (both directions on straightaway)
3. 110 meter hurdles (both directions on straightaway)

4. 200 meter hurdles
5. 400 meter run
6. 800 meter run
7. 1500 meter run
8. 1600 meter run
9. 3000 meter run
10. 3200 meter run
11. 4 x 100 meters relay
12. 4 x 200 meters relay
13. 4 x 400 meters relay
14. 4 x 800 meters relay
15. 4 x 1600 meters relay

SPECIAL NOTES

1. Two turn stagger
2. Three turn stagger (4 x 400 meter relay)
3. Four turn stagger (4 x 200 meter relay)
4. California box start - Break line will be at beginning of first straightaway. Use dotted line. (By 1500 meter start)
5. Different colored line between lanes 4 & 5. It should go around track approximately 300 meters and stop at the beginning of the last straightaway. It could start at the beginning of the two-turn stagger.

FIELD EVENTS

1. The long jump marks should be placed at 8 feet and 12 feet from pit. Also, painted line at 4 feet for younger athletes.
 2. Triple jump marks should be placed at 20 feet, 24 feet, 28 feet, 32 feet, 36 feet and 40 feet. Mark each starting point.
- C. Provide calculations by a TCS. Layout events by a NYS Licensed Land Surveyor with a written letter guarantee verifying accuracy of the markings.
- D. Place event lines and markings with proper alignment and dimensions. Protect all adjacent surfaces to remain with tape, drop cloth, or other approved means. Apply at rates as recommended by the manufacturer. Lines shall be sharp and clean with no overspraying along edges.
- E. Identify all markings, when appropriate, by painting the identification directly onto the track surface in 4" letters just below or in front of each mark in the right hand portion of the lane. Paint all of the large (3' high) lane numbers (4 sets) in 2 colors (shadowed backgrounds). All lines shall receive sufficient paint to assure complete opacity and uniformity of color. Thin paint only when hot weather dictates some thinning for smooth application is required.
- F. Install any school text, logos, and graphics as noted on the drawings and details.

3.04 POLE VAULT, TRIPLE/LONG JUMP, AND HIGH JUMP RUNWAYS

- A. Install as described for the track surface.

3.05 STEEPLE CHASE WATER JUMP PIT AND COVERS

- A. Install resilient track surface as described for track surface. Adhere resilient surface to steeple chase pit covers and steeple chase hurdle sleeve covers per track manufacturer's recommendations.

3.06 FIELD QUALITY CONTROL

- A. Prior to final acceptance, core three (3), 3" diameter areas of the track surfacing where directed by the Architect. Consistency and density will be evaluated. Patch core areas as directed by the Architect to match adjacent density and texture.
- B. If cores vary significantly from the sample, provide additional cores as directed by the Architect. Once the overall general quality is determined, provide remedial work as directed by the Architect to achieve the quality as specified. Costs for coring, patching and remedial work shall be paid by this Contractor at no additional cost to the Owner.

3.07 CLEAN UP

- A. During the contract and at intervals as directed by the Architect and as track construction is completed, clear the site of all extraneous materials, rubbish, or debris and leave the site in a clean, safe, well draining, neat condition.

END OF SECTION

SECTION 32 30 01

ATHLETIC EQUIPMENT AND FURNISHINGS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. The extent of athletic equipment and furnishings is shown on the drawings and as specified in the contract documents.
- B. Athletic equipment and furnishings work includes, but is not limited to, the following:
 - 1. Providing, installing, and turning over select athletic equipment and furnishings as noted in the specifications and as detailed.
 - 2. Cleanup
- C. Provide all labor, materials, tools and equipment necessary to install athletic equipment and furnishings as indicated on the plans and as specified.
- D. The installation of all new materials shall be performed in strict accordance with the manufacturer's installation instructions and in accordance with all approved shop drawings and submittals.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 31 22 01 – Site Earthwork
- B. Section 32 13 01 – Site Concrete Work

1.03 REFERENCES

- A. National Federation of State High School Associations (NFHS)
- B. American Sport Builders Association (ASBA)
- C. Manufacturers Data and Recommended Installation Requirements

1.04 SUBMITTALS (See Section 31 12 01, 1.05)

- A. Provide Manufacturer's Product Data (MPD), Material Certificate and samples as noted:
 - 1. Long/Triple Jump Pit (Pre-fabricated) with Sand Catchers and Covers: MPD. Sample and sieve analysis of granular sand fill.
 - 2. Discus Circle and Cage with Safety Net: MPD
 - 3. Shot Circle and Toe Board: MPD
 - 4. Shot Put Landing Pit: Sample of stone dust and sieve analysis, MSD sheet for pressure treated timbers.
 - 5. Location Monument: MPD
 - 6. Elastic Curbing: MPD
 - 7. Pole Vault Box with Lid: MPD
 - 8. Steeple Chase System: MPD
 - 9. Communication Boxes: MPD
 - 10. Ball Stopper System 12'H with StormGuard Release: MPD and Engineered Shop Drawings Signed and Stamped by Licensed NYS PE.

11. Softball Baseline Netting System 40'H with StormGuard Release: MPD and Engineered Shop Drawings Signed and Stamped by Licensed NYS PE.
12. Combination Football/Soccer System: MPD
13. Football Goal Post Pads: MPD
14. Wall and Fence Padding, MPD and Shop Drawings

1.05 JOB CONDITIONS

- A. All job conditions in Specification Section 31 22 01 apply.

1.06 QUALITY ASSURANCE

- A. Manufacturer's warranties shall pass to the Owner and certification made that the product materials meet all applicable grade trademarks or conform to industry standards and inspection requirements.

1.07 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver products to project site in wrapped, neat, secure condition. Provide means to unload products from delivery trucks.
- B. Protect all products and installation area from vandalism, theft, other construction, premature use, etc. until Owner acceptance and Architect sign off.
- C. Materials delivered to the site shall be examined for damage or defects in shipping. Any defects shall be noted and reported to the Owners representative. Replacements, if necessary, shall be immediately reordered, so as to minimize any conflict with the construction schedule. Sound materials shall be stored above ground under protective cover or indoors so as to provide proper protection.

1.08 SUBSTITUTIONS

- A. If a product is being submitted as a substitution to the specified product; then the Prime Contractor shall submit and request a product material substitution with his/her bid. The Prime Contractor shall at a minimum provide the following for review by the Architect and Owner:
 1. All submittals as specified herein
 2. Product comparison
 3. Cost Information (including proposal of change in Contract Sum)
 4. Contractor's certification that proposed substitution complies with requirements in the Contract Documents
 5. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

PART 2 - PRODUCTS

2.01 LONG/TRIPLE JUMP PIT WITH SAND CATCHERS & COVERS

- A. Prefabricated aluminum long/triple jump sand pit system including sand catcher assembly and aluminum cover set.
- B. Components: Long/triple jump sand pit system shall be fabricated of 1/8" thick aluminum, having the following attributes:

1. Base form unit: 6"W (150mm) x 6.56'L (2m) fabricated of 0.125in thick aluminum, gusset reinforced construction, male/female keyed feature, bolt-together design. Six (6) required per pit.
 2. Corner base form unit: 6"W (150mm) x 5.66' (1.72m), x 2.14' (0.65m) fabricated of 0.125in thick aluminum, gusset reinforced construction, male/female keyed feature, bolt-together design, with prefabricated 90° corner. Four (4) required per pit.
 3. Sand catcher unit: 12"D (305mm) x 19.6"W (500mm) x 6.56'L (2m) fabricated of 0.125in thick aluminum, gusset reinforced construction, male/female keyed feature, bolt-together design, integrated 45° cover ledge. Includes 25mm (1.0in) deep, 0.9M (3.0ft) long aluminum mesh grate and black perforated rubber mat. Six (6) required per pit (includes runway insert unit).
 4. Corner sand catcher unit: 12"D x 19.6"W x 6.56'L (2m) fabricated of 0.125in thick aluminum, gusset reinforced construction, male/female keyed feature, bolt-together design, integrated 45° cover ledge, with prefabricated 90° corner. Includes 25mm (1.0in) deep, 0.9M (3.0ft) long aluminum mesh grate and black perforated rubber mat. Four (4) required per pit.
 5. Aluminum cover set: Reinforced aluminum welded construction fabricated of 0.125in thick aluminum, recessed to accept 13mm (0.5in) track surfacing, two (2) recessed handles per panel, 45° beveled ends conducive with cover ledge. Eight (8) prefabricated cover panels required per pit.
- C. Two (2) triple/long jump pits with sand catchers and covers required.
- D. Basis of design and standard of quality shall be model SPSCHS JumpForm® and SPCVRHS Pit Cover Assembly Set as manufactured by Sportsfield Specialties, Inc., 888-975-3343, or Architect approved equal.
- E. Granular Sand Fill:
1. Specifically selected granular sand fill consisting of grains of closely-sized, washed and dried silica sand. Shall be white, sub-angular in shape to control compaction. Infiltration rate shall be greater than 35 in/hr, and the material shall have a penetrometer value of 1.9-2.2.
 2. Shall have the following gradation:

Sieve Size	% by Weight Passing
#10	trace
#18	3.0
#35	11.0
#60	43.0
#140	41.0
#270	1.0
Sand	99.4
Silt	0.3
Clay	0.2
 3. Basis of design and standard of quality shall be Tour Grade® 535 Bunker Sand distributed by Fairmount Santrol, 800-255-7263, or Architect approved equal.

2.02 DISCUS CIRCLE

- A. Discus circle shall be ¼" aluminum, 2" x 2" angle profile, with 98-1/2" inside diameter. Basis of design and standard of quality shall be model TRDAA as manufactured by Sportsfield Specialties, Inc., 888-975-3343, or Architect approved equal.
- B. One (1) required.
- C. Concrete pad shall be 4,000 psi as described in Section 321301.

2.03 DISCUS CAGE WITH SAFETY NET

- A. Shall consist of six (6) 4" structural aluminum posts, 36" rolled offset, 14' above grade, installed into a 30" aluminum ground sleeve that enables removal when not in use. Post shall have a single pulley system with cleats to hoist and secure safety net in place.
- B. Safety net shall be a #36 black twisted knotted nylon, 1-3/4" square mesh, UV and weather treated, 352 lb. break strength, 13'H x 54'L.
- C. 7'H x 63'L barrier net of similar material to B, above.
- D. One (1) required.
- E. Basis of design and standard of quality shall be model DCHS High School Discus Cage with model DCHSBNA Backup Net as manufactured by Sportsfield Specialties, Inc., 888-975-3343, or Architect approved equal.

2.04 SHOT CIRCLE AND TOE BOARD

- A. Shot circle shall be ¼" aluminum, 2" x 2" angle profile, with 84" inside diameter. Basis of design and standard of quality shall be model TRSPHAA as manufactured by Sportsfield Specialties, Inc., 888-975-3343, or Architect approved equal.
- B. One (1) required.
- C. Toe board shall be cast aluminum depressed pad shot put toe board (3.25in height), powder coated white, with black sector line identifiers (34.92°). Basis of design and standard of quality shall be model SPTBCARHS as manufactured by Sportsfield Specialties, Inc., 888-975-3343, or Architect approved equal.
- D. Concrete pad shall be 4,000 psi as described in Section 321301.

2.05 SHOT PUT LANDING PIT

- A. Pressure Treated Edging: No. 1 structural grade pressure treated Southern Yellow Pine, free of checks, splits, shakes and cracks, S4S. Ground contact rated amine copper quat (ACQ) (NO-CCA ALLOWED) treatment for all elements which will be installed in contact with the ground. Size(s) as shown on drawings.
- B. One (1) required.
- C. Connectors: Shall be new, first quality and commercially manufactured as follows:
 - 1. Anchor: #4 newly deformed billet steel reinforcing bars, free of rust and oxidation, conforming to ASTM A615, grade 60.

- 2. Nail: Galvanized twelve (12") inch long dock spike for timber to timber connections.
- D. Limestone Screenings Landing Pit: Shall be a limestone screenings which is a by-product of crushing process meeting the following gradation:

Sieve Size	% by Weight Passing
1/4"	100
4	99.5
1/8"	93.0
8	80.0
10	73.4
16	50.0
20	41.3
30	31.5
40	24.8
50	18.0
80	11.6
100	9.4
200	7.3

2.06 LOCATION MONUMENT (Provide 2)

- A. Shall be galvanized threaded rod, free of rust and straight. Size as shown.
- B. Concrete shall be 4,000 psi as specified in Section 321301.

2.07 ELASTIC CURBING

- A. At "D" edge transition from artificial (or natural turf) to resilient track, shall be ACO System 7000 Elastic Curb, polymer concrete construction, encapsulated 2" black EPDM capping, 9.8" overall height.
- B. Standard of quality shall be as distributed by Sportsfield Specialties, Inc. 888-975-3343 or Architect approved equal.

2.08 POLE VAULT BOX WITH LID

- A. Pole vault box shall be 1/2" cast aluminum with rounded edges to minimize pole wear and a white powder coated finish. Standard of quality shall be model PVBCAW as manufactured by Sportsfield Specialties, Inc., 888-975-3343, or Architect approved equal.
- B. Provide one (1) pole vault box and lid.
- C. Vault box cover plug shall be 1/8" formed aluminum, designed to fill the void of the pole vault box, with 12mm recess to accept synthetic track material. Standard of quality shall be model PVBCPCA as manufactured by Sportsfield Specialties, Inc., 888-975-3343, or Architect approved equal.
- D. Concrete foundation shall be 4,000 psi as described in Section 321301.

2.09 STEEPLE CHASE WATER JUMP PIT SYSTEM

- A. Aluminum steeple chase water jump pit including water jump pit form, water jump pit cover, adjustable water jump barrier and barrier seal.

- B. Components: Water jump pit shall be fabricated of 1/8" thick aluminum, having the following attributes:
1. Side and rear panels: Double-wall, gusset reinforced construction, tapered side wall with 22.4% slope, slip joint bolt-together construction, built-in screed edge guide for synthetic surfacing materials
 2. Drainage valve: Fully integrated, 3" PVC outlet, built-in valve body, serviceable sealed plate at bottom of front wall.
 3. Waterstop: Continuous at floor/side wall joint.
 4. Barrier sleeves: Aluminum sleeves located at universal men's/women's position.
 5. Cover ledge: Prefabricated cover ledge conducive with standard cover set, include removable ledge filler panels. Recessed 0.5 inches for synthetic surfacing
 6. Pit cover assembly: Self-supporting reinforced aluminum construction, recessed to accept 0.5 inches track surfacing, two (2) recessed handles per panel. Six (6) cover panels required (includes tapered wedge cover)
 7. Jump barrier/hurdle: 5" x 5" adjustable water jump hurdle, powder coated aluminum beam factory wrapped with 12mm synthetic track material.
 8. Portable hurdle set: Aluminum powder coated white with painted white and black beams. Stainless steel hardware.
 - a. Components:
 1. Ground bars fabricated of 4" square tubing with 1.4" aluminum end plates.
 2. Adjustable legs fabricated of 4" square tubing and 3" schedule 40 pipe with 1/4" aluminum mount plates
 3. Beams fabricated of 4" square tubing wrapped in synthetic track surface.
 9. T-handle keys for opening and closing drainage valve. Provide 2.
 10. Hurdle wheel device. Provide 2.
- C. Basis of design and standard of quality shall be model SCWJFS Steeple Chase Forming System, SCWJH Water Jump Hurdle with Barrier Seal, SCWJCVR Aluminum Cover Set, SCHS Portable Hurdle Set, and WJ5040 Hurdle Wheel Device as manufactured by Sportsfield Specialties, Inc., 888-975-3343, or Architect approved equal.

2.10 COMMUNICATION BOXES

For Use in Asphalt/Concrete Areas:

- A. Shall be 18"W x 30"L x 14"H constructed of 3/16" aluminum. Cover is made of 1/8" aluminum (plywood unacceptable) and includes flexible gasket seals. Cover shall be recessed 0.5 inches to accept factory installed recycled rubber black mat. Shall have two (2) hand holes. Secured with two cover panel locks. Stainless steel leveling bolts and assembly hardware.
- B. Basis of design and standard of quality shall be model CBBM1830 ComBox® as manufactured by Sportsfield Specialties, Inc., 888-975-3343, or Architect approved equal.

For Use in Natural Grass:

- A. Shall be 18"W x 30"L x 14"H constructed of 3/16" aluminum, for natural grass installation. Cover is made of 1/8" aluminum (plywood unacceptable) and includes flexible gasket seals to prevent topsoil migration. Cover shall be recessed to accept synthetic infill turf.

Shall have two (2) 10-1/8" diameter hand holes with circular lids; lids to have "turn and lock" feature.

- B. Basis of design and standard of quality shall be model CBNG1830 ComBox® as manufactured by Sportsfield Specialties, Inc., 888-975-3343, or Architect approved equal.

For Use in Synthetic Turf:

- A. Shall be 18"W x 30"L x 14"H constructed of 3/16" aluminum, for synthetic turf installation. Cover is made of 1/8" aluminum (plywood unacceptable) and includes flexible gasket seals to prevent infill migration. Cover shall be recessed to accept synthetic infill turf. Shall have one (1) 10-1/8" diameter hand holes with circular lids; lids to have "turn and lock" feature.
- B. Basis of design and standard of quality shall be model CBIT1815 ComBox® as manufactured by Sportsfield Specialties, Inc., 888-975-3343, or Architect approved equal.

2.11 BALL STOP NETTING SYSTEM (12ft H with StormGuard Release)

- A. Shall be 2"OD heavy wall (Schedule 40) aluminum uprights (12'-0" exposed height) installed into 48" ground sleeves. Uprights to be powder coated black. Shall have 1/4" vinyl coated galvanized cable integrated at top/bottom; attach net to uprights via stainless steel snap clips and raised by rope tether and pulley system. Shall be equipped with Storm Guard Breakaway System at each pole. The net shall be 12' above finished grade, and of the following quality: #36 black twisted knotted nylon, 1-3/4" square mesh, UV and weather treated, with 345 lb minimum breaking strength per bar of netting. Include ground sleeve caps. Assembly hardware shall be stainless steel and/or galvanized steel. Provide black plastic friction lock ground sleeve caps.
- B. StormGuard Break-Away System: Design to allow net to release and fall to ground prior to failure of poles or hardware. Shall utilize a 150 lb. break strength aluminum shear pin.
- C. Provide minimum four (4) "breaks" in the ball stop netting, in locations as directed by the Architect.
- D. Basis of design and standard of quality shall be model BSS412 Straight Pole Storm Guard Breakaway Ball Safety Netting System as manufactured by Sportsfield Specialties, Inc., 888-975-3343, or Architect approved equal.

2.12 SOFTBALL BASELINE NETTING SYSTEM (40ft H with StormGuard Release)

- A. Shall be 6.625"OD heavy wall (Schedule 40) aluminum uprights (40'-0" exposed height) installed into 48" ground sleeves. Uprights to be powder coated black. Shall have 1/4" vinyl coated galvanized cable integrated at top/bottom; attach net to uprights via stainless steel snap clips and raised by rope tether and pulley system. Shall be equipped with Storm Guard Breakaway System at each pole. The net shall be 40' above finished grade, and of the following quality: #36 black twisted knotted nylon, 1-3/4" square mesh, UV and weather treated, with 345 lb minimum breaking strength per bar of netting. Include ground sleeve caps. Assembly hardware shall be stainless steel and/or galvanized steel. Provide black plastic friction lock ground sleeve caps.
- B. StormGuard Break-Away System: Design to allow net to release and fall to ground prior to failure of poles or hardware. Shall utilize a 150 lb. break strength aluminum shear pin.

- C. Basis of design and standard of quality shall be model FSNS64040 Straight Pole Storm Guard Breakaway Ball Safety Netting System as manufactured by Sportsfield Specialties, Inc., 888-975-3343, or Architect approved equal.

2.13 COMBINATION FOOTBALL/ROUND FACED SOCCER SYSTEM

- A. Basis of design and standard of quality shall be GPKR20HS GoalPak as manufactured by Sportsfield Specialties, Inc., 888-975-3343, or Architect approved equal.
- B. Provide one (1) pair of football and soccer goals.
- C. Components:
 - 1. GP820HS AdjustRight Football Goal Post(s):
 - a. Gooseneck Support: #4285 fabricated of 6" Schedule 40 aluminum pipe (6-5/8"OD), 5' radius, 8' offset.
 - b. Crossbar: #4231 fabricated of 6" Schedule 40 aluminum pipe (6-5/8"OD).
 - 1. Length: 23'-4" (inside of upright to inside of upright)
 - 2. With internal rotating sleeve for upright adjustment; utilizes precision fit textured mating surfaces for locking into the vertical position (roll pins unacceptable)
 - c. Uprights: #4226 fabricated of extruded 6061 T6 aluminum tube (4" OD) with rigid wire loop at upper end.
 - 1. Length: 20'
 - d. Powder Coat Finish: Yellow or White. Owner to select.
 - e. Installation package consisting of the following components:
 - 1. Ground Sleeve: #4212 fabricated of 8" Schedule 40 steel pipe, 5' long
 - 2. Access Frame: #4516 fabricated of 3/16" aluminum, 22-1/4" square x 6" tall, with eight anchor bolts. Includes integrated turf attachment ledge. Provide synthetic turf to cover lid.
 - 3. Filler Plugs fabricated of 3/16" aluminum (plywood unacceptable), to be adhered with synthetic infill turf on site.
 - 4. Access Frame and Filler Plugs are to include flexible gasket seals to prevent horizontal infill migration for turf applications (factory installed; inside and outside perimeters).
 - f. Accessories:
 - 1. Directional wind flags
 - 2. Touch-up paint (powder coat specific)
 - 3. Assembly hardware
 - 2. SG824R Round Post Soccer Goal(s):
 - a. Cross Bar: #4950-TOPCROSSBAR Fabricated of 6061 T6 extruded aluminum tube, 4.375" x 4.688", having the following attributes:
 - 1. Length: 24' (inside of upright to inside of upright)
 - 2. Round face with radiused backside corners
 - 3. 7 gauge powder coated steel crossbar attachment brackets
 - 4. Powder coated white
 - b. End Frame: #4950-ENDFRAME fabricated of 6061 extruded aluminum tube having the following attributes:
 - 1. Upright posts, 4.375" x 4.688", round face with radiused backside corners
 - 2. Rolled side frame, 2" x 3" x .1/8" wall thickness, tig welded to upright posts

- 3. Powder coated white
 - c. Ground Bar: #4950-BOTTOMGROUNDBAR fabricated of 6061 T6 extruded aluminum tube, 2" square x .1/4" wall thickness, having the following attributes:
 - 1. Powder coated white
 - d. Accessories:
 - 1. Welded aluminum net clips, guaranteed for life
 - 2. Soccer Net: 4mm braided polyethylene, 4" square mesh, orange
 - 3. Stainless steel assembly hardware
3. SGMKR SGMobile - Soccer Goal Portable Wheel Mobility Kit:
- a. Soccer Goal Wheel Insert
 - 1. Welded 13 gauge stainless steel frame
 - 2. UHMW plastic wheel
 - 3. Stainless steel hardware
 - b. Soccer Goal Mobility Handle
 - 1. Formed 3/8" stainless steel round stock
 - 2. Stainless steel hardware
 - 3. Powder coated white.
4. SG2SGP - Soccer Goal Back Bar Safety Clamp Kit:
- a. #SG2S-GP Safety Clamp
 - 1. Fabricated of 1/4" aluminum
 - 2. Powder coated white
 - 3. Quick release hardware
 - 4. For use with Access Kit
5. Concrete shall be 4,000 psi as described in Section 321301.

2.14 FOOTBALL GOAL POST PADS

- A. Fully Encased Vinyl Covering: 19 oz Vinyl - 19 Oz Polyester Scrim Coated Vinyl, Grab Tensile; 450 x 450 lbs./in, Tongue Tear: 84 x 85 Lbs. Vinyl cover is stitched using polyester thread, color: Black. Covering Color: Provide color chart to match School colors.
- B. Filler Foam: 18" Outside diameter polyurethane foam core - Density (PCF): 1.3 +/- .05., Indention load deflection: 40 U 48 lbs. at 25% compression, Tear Strength: 1.5-2.5 lbs./inch.
- C. Attachment: Center of polyurethane foam core is cutout to fit specific pole diameter (up to 6") - Velcro attachments sewn the entire 6" height of the pad to secure the core.
- A. Custom lettering as shown on the drawings. Lettering color shall be selected by owner. Provide color chart.
- B. Provide one (1) pair.
- F. Standard of quality shall be Model GPPRDG Round as manufactured by Springfield Specialties, Inc., 888-975-3343, or Architect approved equal.

2.15 WALL PADDING

- A. Standard of quality shall be ProZone® Premium Field Wall Padding and Accessories as manufactured and/or supplied by Sportsfield Specialties, Inc., 888-975-3343, or Architect approved equal.
- B. ProZone® Premium Field Wall Padding:
1. Engineered 3" High-Density Polyurethane (HDPU) Open Cell Foam
 - a. Designed to Provide Soft "Feel" Upon Mild Contact while Safely Absorbing Maximum Impact Velocities
 - b. Superior Resilience at High Impacts and Multi-Strike Energy Management
 - c. Engineered to Maximize Impact Absorption While Limiting Thermal Variation That Causes Wrinkles
 - d. Density: 2.10 +/- 0.10 pcf (ASTM D3574)
 - e. Impression Load Deflection (4" x 25" x 25" Sample)
 - a. 25%: 80 – 100 (ASTM D3574)
 - b. 65%: 128 – 145 (ASTM D3574)
 - f. Support Factor 65/25: 1.7 min (ASTM D3574)
 - g. Resilience (% Rebound): 40 – 48 (ASTM D3574)
 - h. Tear Resistance: 1.0 – 2.0 lbs/in (ASTM D3574)
 - i. Static Fatigue (Procedure A: 75% Deflection, 17 hrs):
 - a. % Loss @ 25% ILD: Less than 30 (ASTM D3574)
 - b. % Loss in Thickness: Less than 5 (ASTM D3574)
 - j. Flammability: Passes with Class 1 Fabric (California TB 117-2013)
 2. Premium Outdoor Vinyl Encasement:
 - a. High UV Resistance
 - b. Total Weight: 19 oz./yd² (ASTM D3776)
 - c. Construction: 18 x 18, 1300 x 1300 Denier
 - d. Grab Tensile: Warp 750 lb/2", Fill 655 lb/2". (ASTM D5034)
 - e. Tongue Tear: Warp 153 lb/in., Fill 135 lb/in (ASTM D2261)
 - f. Adhesion: 38 lb/2" (ASTM D571)
 - g. Flame Resistance: Class 1 (ASTM E-84), CFSM, NFPA-701
 - h. Cold Crack: -30° F (ASTM D2136)
 - i. Rot, Mildew and Fungus Resistant: Yes
 - j. Color as selected by Owner.
 3. 3/4" Square Edge AdvanTech® Water Resistant Sheathing Panel; All Sides Stained and Sealed with Exterior Grade Finish
 4. Stainless Steel Staples and Applicable Hardware
 5. Wall Mounting Hardware:
 - a. Aluminum Z-Clip Wall Mounting Hardware or Bolt and Back-up Plate Chain Link Fence Attachment Hardware
 6. Impact Testing; Independently Certified:
 - a. ASTM F2440; 10 lb. x 6.3" Dia. Hemisphere Head Form, 4' Drop Height (Impact Velocity: 10.9 MPH):
 - a. G-max: 44
 - b. Head Injury Criterion (HIC): 115
 - b. Head Injury Criterion (HIC) Impact Test: 10 lb. x 6.3" Dia. Hemisphere Head Form, 5' Drop Height (Impact Velocity: 12.2 MPH):
 - a. G-max: 51
 - b. Head Injury Criterion (HIC): 154
 - c. Head Injury Criterion (HIC) Impact Test: 10 lb. x 6.3" Dia. Hemisphere Head Form, 9' Drop Height (Impact Velocity: 16.4 MPH):
 - a. G-max: 134
 - b. Head Injury Criterion (HIC): 578
 7. 3-Year Manufacturer's Limited Product Warranty
 8. Provide graphics for Owner approval that read "LOWVILLE".

2.16 DUGOUT FENCE PADDING

A. Components:

1. BaseZone® Chain-Link Post Padding, Sewn Grommet
 - a. Dimensions: 6"W x Variable Length x 3" Thick
 - b. 3" Thick High Impact 1580 Polyurethane Foam
 - i. Density: 1.45 – 1.55 pcf (ASTM D3574)
 - ii. Impression Load Deflection (4" x 25" x 25" Sample)
 1. 25%: 75 – 85 (ASTM D3574)
 2. 65%: 128 – 145 (ASTM D3574)
 3. Support Factor 65/25: 1.7 min (ASTM D3574)
 - iii. Resilience (% Rebound): 40 – 48 (ASTM D3574)
 - iv. Tear Resistance: 1.5 – 2.5 lbs/in (ASTM D3574)
 - v. Static Fatigue:
 1. % Loss @ 25% ILD: Less than 35 (ASTM D3574)
 2. % Loss in Thickness: Less than 10 (ASTM D3574)
 - vi. Flammability: Passes with Class 1 Fabric (California TB 117-2013)
 - c. Outdoor Vinyl Encasement:
 - i. High UV Resistance: 3000 hrs (QUV-A)
 - ii. Total Weight: 18 oz./yd² (ASTM D751)
 - iii. Emboss: Course Matte
 - iv. Construction: 9 x 9, 1000 x 1000 Denier
 - v. Tongue Tear: Warp 50 lbs., Fill 40 lbs. (ASTM 2261)
 - vi. Grab Tensile: Warp 250 lbs., Fill 240 lbs. (ASTM D751)
 - vii. Adhesion: 15 lbs. (ASTM D751)
 - viii. Flame Resistance: Class 1 (ASTM E-84)
 - ix. Abrasion (H18, 1,000g load): 1000 Cycles (ASTM D3389)
 - x. Rot, Mildew and Fungus Resistant: Yes (ASTM-G21, 0-1)
 - xi. Various Standard Colors Available
 - d. Vinyl Seams Double Stitched Using 6 lb. Bonded Polyester Black Thread
 - e. Includes Two (2) 1.5"W Vinyl Flaps with #2 Stainless Steel Grommets 12" On-Center
 - i. Secured to Chain-Link Fence Using 14"L x 50 lb. Break Strength UV Resistant Nylon Zip-Ties
 - f. 1-Year Manufacturer's Limited Product Warranty
2. BaseZone® Chain-Link Top Rail Padding, Sewn Grommet:
 - a. Dimensions: 9" Face x 6" Top Return (3" Notch) x Variable Length
 - b. 3" Thick High Impact 1580 Polyurethane Foam
 - i. Density: 1.45 – 1.55 pcf (ASTM D3574)
 - ii. Impression Load Deflection (4" x 25" x 25" Sample)
 1. 25%: 75 – 85 (ASTM D3574)
 2. 65%: 128 – 145 (ASTM D3574)
 3. Support Factor 65/25: 1.7 min (ASTM D3574)
 - iii. Resilience (% Rebound): 40 – 48 (ASTM D3574)
 - iv. Tear Resistance: 1.5 – 2.5 lbs/in (ASTM D3574)
 - v. Static Fatigue:
 1. % Loss @ 25% ILD: Less than 35 (ASTM D3574)
 2. % Loss in Thickness: Less than 10 (ASTM D3574)
 - vi. Flammability: Passes with Class 1 Fabric (California TB 117-2013)
 - c. Outdoor Vinyl Encasement:
 - i. High UV Resistance: 3000 hrs (QUV-A)
 - ii. Total Weight: 18 oz./yd² (ASTM D751)
 - iii. Emboss: Course Matte
 - iv. Construction: 9 x 9, 1000 x 1000 Denier

- v. Tongue Tear: Warp 50 lbs., Fill 40 lbs. (ASTM 2261)
 - vi. Grab Tensile: Warp 250 lbs., Fill 240 lbs. (ASTM D751)
 - vii. Adhesion: 15 lbs. (ASTM D751)
 - viii. Flame Resistance: Class 1 (ASTM E-84)
 - ix. Abrasion (H18, 1,000g load): 1000 Cycles (ASTM D3389)
 - x. Rot, Mildew and Fungus Resistant: Yes (ASTM-G21, 0-1)
 - xi. Various Standard Colors Available
 - d. Vinyl Seams Double Stitched Using 6 lb. Bonded Polyester Black Thread
 - e. Includes Two (2) 1.5"W Vinyl Flaps with #2 Stainless Steel Grommets 12" On-Center
 - i. Secured to Chain-Link Fence Using 14"L x 50 lb. Break Strength UV Resistant Nylon Zip-Ties
 - ii. Note: The Applicable Chain-Link Fence Must Be Flush Across the Top to Permit an Appropriate Top Rail Pad Installation; Vertical Posts Cannot Extend Above the Chain-Link Fabric Nor the Horizontal Top Rail (If Present).
 - f. 1-Year Manufacturer's Limited Product Warranty
- B. Provide at all chain link in front of dugouts at multipurpose turf field.
- C. Standard of quality shall be BCLTRPSG Chain-Link Top Rail Padding and BCLPPSG Chain-Link Post Padding as manufactured by Sportsfield Specialties, Inc., 888-975-3343, or Architect approved equal.

PART 3 - EXECUTION

3.01 LONG/TRIPLE JUMP PIT WITH SAND CATCHERS & COVERS

- A. Install jump pit sand catchers per manufacturer's recommendations.
- B. Install settled depth of specified sand.
- C. Install pit covers as detailed and per manufacturer's recommendations. Resilient track surface shall be applied to cover recess.

3.02 DISCUS CIRCLE

- A. Construct concrete pad for discus circle as detailed, complete with drainage tubes through pads. Fill tubes with coarse sand.
- B. Anchor discus circle to concrete as detailed.

3.03 DISCUS CAGE WITH SAFETY NET

- A. Install ground sleeve and eye bolt as detailed.
- B. Install posts and nets per manufacturer's instructions.
- C. Once Architect has approved installation and equipment, remove posts and nets and turn over to the Owner.

3.04 SHOT CIRCLE AND TOE BOARD

- A. Construct concrete pad for shot circle as detailed with 3/4" recess.

- B. Anchor shot circle and toe board securely into concrete as detailed.

3.05 SHOT PUT LANDING PIT

- A. Construct pit as detailed with flush edging.
- B. Set wood framing accurately to required lines and levels. Provide framing members of sizes and on spacings shown. Cut, joint, and tightly fit framing around other work. Do not splice structural members between supports.
- C. Use only NON-CCA pressure-treated, sound, thoroughly seasoned materials of longest practical lengths and sizes to minimize joints. Use materials free of warp, unless warp can be easily corrected by anchorage and attachment. Make tight butt connections between members. Cuts shall be clean, sharp and straight.
- D. Make connections firm and secure without wobble or free movement. Flush screw and nail heads. Counter sink lag bolts and plug holes as required on drawings.
- E. Sand smooth wood surfaces that may be in human contact. Remove sharp or rough edges, and splinters.
- F. Brush application of two coats Cuprinol brand preservative to field cuts.
- G. Install limestone screenings as shown on the drawings. Settled depth of limestone screening shall be flush with timbers.

3.06 LOCATION MONUMENT (Provide 2)

- A. Accurately locate monument.
- B. Core hole for monument to depth indicated on drawings and fill to elevation indicated on drawings with concrete.
- C. Install threaded rod as shown. Position of center of rod shall mark location of monument as dimension on plans. Set rod plumb.
- D. Install a temporary wooden stake over monument for field verification of subsurface location monument. Remove wooden stake as directed by the Architect.

3.07 ELASTIC CURBING

- A. Install per manufacturer's instructions and as detailed.

3.08 POLE VAULT BOX WITH LID

- A. Anchor pole vault boxes securely into concrete foundations. Construct flush with finished grade.
- B. Drill two 3/8" drain holes through pole vault box and concrete foundation. Drain into stone pit as detailed.

3.09 STEEPLE CHASE WATER JUMP PIT SYSTEM

- A. Install per manufacturer's instructions and as detailed.

3.10 COMMUNICATION BOXES

- A. Site Contractor shall install per drawings and manufacturer's recommendations. The Site Contractor shall provide complete excavation, trenching, bedding, conduit, pull strings, backfill and compaction. Wiring will be provided and installed by the Electrical Contractor.

3.11 BALL STOP NETTING SYSTEM (12ft H with StormGuard Release)

- A. Install in areas as shown on the plans and detailed. Review layout with Architect prior to installation. Install ground sleeves as recommended by manufacturer and as directed by the Architect.

3.12 SOFTBALL BASELINE NETTING SYSTEM (40ft H with StormGuard Release)

- A. Install in areas as shown on the plans and detailed. Review layout with Architect prior to installation. Install ground sleeves as recommended by manufacturer and as directed by the Architect.

3.13 COMBINATION FOOTBALL/ROUND FACED SOCCER SYSTEM

- A. Install as shown on the plans and as directed by the manufacturer.

3.14 FOOTBALL GOAL POST PADS

- A. Install as shown on the plans and as directed by the manufacturer.

3.15 WALL PADDING

- A. Install as directed by the manufacturer.

3.16 DUGOUT FENCE PADDING

- A. Install as directed by the manufacturer.

3.17 CLEAN UP

- A. During the contract and at intervals as required by the contract documents and as directed by the Architect and as field event furnishings are installed, clear the site of all extraneous materials, rubbish, and debris. Leave the site in a clean, safe, well-draining, neat condition.

END OF SECTION

SECTION 32 30 02

TRAFFIC SIGNS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. The extent of traffic signs are shown on the drawings.
- B. Provide materials, labor, equipment, and services required to accomplish related work in accordance with the drawings and specifications.

1.02 SUBMITTALS: (Provide Section 31 12 01, 1.05)

- A. Provide shop drawings for each different type and size of sign listed in the Traffic Sign Schedule.
- B. Provide MPD for sign posts and plates.

1.03 JOB CONDITIONS

- A. Job conditions in Section 312201 apply.
- B. No work shall be fabricated until shop drawings for the work have been favorably reviewed by the Architect.
- C. Construction Review: Notify the Architect when locations for signs are coordinated to avoid underground utilities and marked in the field for review.
- D. Provide sleeves, anchors, footings and other items and build in coordination with work of other trades.

PART 2 - PRODUCTS

2.01 SIGNS

- A. Sign Plate:
 - 1. Sign Plate shall be aluminum sheets .090" (approximately 3/32") thick, with two coats of Dupont Imron spray semigloss paint.
 - 2. Letters, numbers, symbols, and arrows shall be engineering grade, (EG) reflective. Sign plates, letters and numbers shall meet the colors and regulations described in the "Manual of Uniform Traffic Control Devices", latest edition, as published by the State of New York Department of Transportation, Division of Traffic and Safety.
 - 3. The following Traffic Sign Schedule shall apply:

SIGN WORDING	SIGN NO.	SIZE	LETTER SIZE AND SERIES
Stop	R1 - 1C	30" x 30" and Red	10"C/White

HC Reserved Parking w/ Van Accessible	P4 - 6C P3-8(NY)	12" x 18" 12" x 6"	2" Green/White Blue Background 2" Green/White Background
No Parking Any Time	P1-1	12" x 18"	3"C/Red on White

4. Refer to Traffic Sign Schedule and/or sign details on drawings for sign wording, quantities, and other information.
5. Hardware shall be galvanized.
6. Standard of quality shall be as manufactured by Eastern Metal/USA-Sign, www.usa-sign.com or Architect approved equal.

B. Breakaway Signposts:

1. Shall be minimum 2.5 lbs. / ft high carbon new billet steel (SP-80) U-channel posts with predrilled 3/8" holes at 1" on center.
2. Crashworthy to NCHRP 350 criteria. Meeting FHWA (Federal Highway Administration) for small sign support applications.
3. Lap Splice U-channel Breakaway System shall be 3/8" x 3/4" x 5" and sized to post, bar color silver. Special manufacturer designed bolts for lap splice are required.
4. Hot dipped galvanized as directed by the Architect.
5. Standard of quality shall be "Rib-Bak" U-channel signposts as manufactured by NUCOR Steel Marion, Inc. www.nucorhighway.com (800) 333-4011 or Architect approved equal.

PART 3 - EXECUTION

3.01 INSTALL SIGNS

- A. Erect signs plumb. Drive posts into firm ground or bolt to sleeve in pavement areas or concrete footings as detailed. Use driving caps to avoid deforming posts.
- B. Mount sign plates at heights detailed. Attach metal sign plates to steel posts securely with 1/4" galvanized allen head screws.
- C. Place "TRACK REGULATIONS" signs at each gate entry and as indicated on the plans. Install on fence and anchor securely with vandal resistant hardware.

3.02 CLEAN UP

During the contract and at intervals as directed by the Architect and as traffic sign installation(s) are completed, clear the site of extraneous paint, fasteners, concrete, gravel, asphalt and debris. Leave the site in a clean, safe, well draining, neat condition.

END OF SECTION

SECTION 32 30 03

METAL BOLLARDS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. The extent of metal bollards is shown on the drawings and as specified in the contract documents.
- B. Metal bollards work includes, but is not limited to, the following:
 - 1. Providing and installing metal bollards and furnishings as noted in the specifications and as detailed.
 - 2. Cleanup
- C. Provide all labor, materials, tools, equipment, and services required to install metal bollards and furnishings as indicated on the plans and as specified.
- D. The installation of all new materials shall be performed in strict accordance with the manufacturer's installation instruction and in accordance with all approved shop drawings and submittals.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 32 13 01 - Site Concrete Work

1.03 REFERENCES

- A. Manufacturers Data and Recommended Installation Requirements

1.04 SUBMITTALS: (See Section 31 12 01, 1.05)

- A. Provide Manufacturer's Product Data (MPD), Material Certificate and samples as noted:
 - 1. Metal Bollard Cover (1/4" nominal wall thickness polyethylene thermoplastic): MPD
 - 2. Metal Bollard Cover (1/4" nominal wall thickness polyethylene thermoplastic): Sample and Color Selection Chart
 - 3. Reflective Tape: MPD and Sample

1.05 JOB CONDITIONS

- A. Job conditions in Section 31 22 01 apply.
- B. Construction Review: Notify the Architect when footing location(s) for metal bollards are coordinated to avoid underground utilities and marked in the field.

1.06 QUALITY ASSURANCE

- A. Manufacturer's warranties shall pass to the Owner and certification made that the product materials meet all applicable grade trademarks or conform to industry standards and inspection requirements.
- B. Ten (10) year warranty against fading.

1.07 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver products to project site in wrapped, neat, secure condition. Provide means to unload products from delivery trucks.
- B. Protect all products and installation area from vandalism, theft, other construction, premature use, etc. until Owner acceptance and Architect sign off.
- C. Materials delivered to the site shall be examined for damage or defects in shipping. Any defects shall be noted and reported to the Owners representative. Replacements, if necessary, shall be immediately reordered, so as to minimize any conflict with the construction schedule. Sound materials shall be stored above ground under protective cover or indoors so as to provide proper protection.

PART 2 - PRODUCTS

2.01 METAL BOLLARD

- A. Pipe: Shall be galvanized schedule 40 steel pipe, 6 inch ID, 6.625" OD.
- B. Concrete: Shall be 4000 psi as specified in Section 321301.

2.02 REFLECTIVE TAPE: Shall be exterior grade, reflective. Standard of quality shall be Scotchgard, as manufactured by 3M or Architect approved equal. Color as noted on detail.

2.03 BOLLARD COVER: Shall be made of ¼" nominal wall thickness polyethylene thermoplastic (LDPE). Top shall be domed. Standard of quality shall be as manufactured by Ideal Shield or Architect approved equal. Color shall be selected by Owner, and approved by Architect.

PART 3 - EXECUTION

3.01 INSTALL METAL BOLLARD

- A. Shop cut bollard.
- B. Locate per plan and install as detailed. Neatly saw cut pavement or install bollards before paving.
- C. Auger hole for concrete footing. Set metal bollard in center of hole and brace plumb and vertical.
- D. Fill annular spaces around and inside metal bollard with concrete. Dome top of concrete footing and concrete inside metal bollard to shed water. Check for plumb alignment.
- E. When concrete has set, remove braces.
- F. Install bollard cover and reflective tape per manufacturer's recommendations.
- G. Finished metal bollard shall be set plumb. Cover shall be smooth and free of chipped or cracked areas. Protect bollards until accepted.

3.02 CLEAN UP

During the contract and at intervals as required by the contract documents and as directed by the Architect and as metal bollards are installed, clear the site of all extraneous materials, rubbish, and debris. Leave the site in a clean, safe, well-draining, neat condition.

END OF SECTION

SECTION 32 30 04

FLAGPOLE(S)

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. The extent of new flagpole(s) is shown on the drawings.
- B. Provide materials, labor, equipment and services required to accomplish related work in accordance with the drawings and specifications.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 32 13 01 - Site Concrete Work

1.03 SUBMITTALS: (See Section 31 12 01, 1.05)

- A. Provide Manufacturer's Product Data (MPD):
 - 1. Flagpole and Accessories

1.04 JOB CONDITIONS

- A. Job conditions in Section 31 22 01 apply.
- B. Construction Review: Notify the Architect when flagpole footing location is coordinated to avoid underground utilities and marked in the field.

PART 2 - PRODUCTS

2.01 FLAGPOLE AND ACCESSORIES (Provide 1)

- A. Downlighter Flagpole: One piece, cone tapered aluminum flagpole, conforming to NAAMM Metal Flagpole Manual.
 - 1. Type: Shoebase Mount
 - 2. Nominal Height: 40'
 - 3. Butt Diameters include: 7"
 - 4. Wall Thickness: .156"
- B. Aluminum ASTM B221.
 - 1. Finish: Black Anodized
- C. Foundation Base: Anchor Base: Cast from A356 alloy aluminum, the shoebase shall be heat-treated to a T-6 condition after attachment to the shaft. The shaft shall be inserted into the shoebase casting. The casting and shaft shall be joined by a continuous circumferential weld at the outside top and inside bottom of the shoebase. Each shoebase flagpole shall include four anchor bolts, two hex nuts, two flat washers and one lock washer, sized to match the anchor bolts.
- D. Flash Collar/Base: High Profile flash collar to accommodate shoebase mount.
- E. Internal Halyard Rope Based System: with cam cleat and locking raised access door.

1. Provide snap hooks
 2. Provide rubber covered counterweight
 3. Provide retainer ring
- F. Double 20 WATT integral lighting system with 120v photocell.
- G. Provide 5' x 8' American Flag with flagpole.
- H. Standard of quality shall be Eagle United NightMaster Downlighter as manufactured by Eagle Mountain Flag, P.O. Box 500, Wimberly, TX 78676, www.eaglemountainflag.com or Architect approved equal.

2.02 CONCRETE FOOTING: Shall be 4,000 psi as specified in Section 32 13 01.

PART 3 - EXECUTION

3.01 INSTALL FLAGPOLE

- A. Locate as shown on drawings. Coordinate footing location to avoid utilities. Install per manufacturer's recommendations. Coordinate with Electrical Contractor for connections.
- B. Set pole vertical and plumb. Brace securely.
- C. Protect flagpole installation from movement and loading until the concrete footing has attained its full design strength (approximately 28 days).
- D. Sand smooth and touch paint scrapes and scratches with compatible matching paint. Protect adjacent surfaces. Clean thoroughly when drips or spills occur.
- E. Install ball, truck, halyards and other flagpole accessories securely.

3.02 CLEAN UP

During the contract and at intervals as directed by the Architect and as flagpole installation is completed, clear the site of gravel, concrete, appurtenances and debris. Leave the site in a clean, safe, well draining, neat condition.

END OF SECTION

SECTION 32 30 05

EXTERIOR SCOREBOARD AND TIMING DISPLAY(S)

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. The extent of the scoreboard and timing display(s) are shown on the drawings.
- B. Work includes, but is not limited to, the following:
 - 1. Main Stadium Single-sided LED multi-sport scoreboard
 - 2. Timing Display
 - 3. Associated auxiliary features
 - 4. Decorative Accents on scoreboards
 - 5. Press Box equipment
 - 6. This contract shall provide and install I-beam posts/footings and attach new scoreboard and/or timing displays.
 - 7. This contract shall provide and install a new single-sided LED scoreboards and timing displays, and associated features
- C. Provide all materials, labor, equipment and services required to accomplish all related work in accordance with the drawings and specifications.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 32 13 01 - Site Concrete Work

1.03 REFERENCES

- A. Standard for Electric Signs, UL-48, 13th Edition
- B. Federal Communications Commission Regulation Part 15
- C. National Electric Code – Latest Edition
- D. Standard for Control Centers for Changing Message Type Signs, UL-1433, 1st Edition
- E. Standard for CAN/CSA C22.2

1.04 SUBMITTALS: (See Section 31 12 01, 1.05)

- A. Product data: Submit manufacturer's product illustrations, data and literature that fully describe the scoreboards and accessories proposed for installation.
- B. Shop drawings:
 - 1. Submit mechanical and electrical drawings.
 - 2. Submit stamped engineered drawings, by a NYS PE.

- 3. Shop drawings shall include structural members and footing design.
- C. Functional system block diagram showing all major equipment and signal flow
- D. Maintenance data: Submit manufacturer's installation, operation, and maintenance manuals.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Product delivered on site.
- B. Scoreboard, timing displays and equipment to be housed in a clean, dry environment.

1.06 PROJECT CONDITIONS

- A. Environmental limitations: Do not install scoreboard equipment until mounting structure is secure and concrete has ample time to cure.
- B. Field measurements: Verify position and elevation of structure and its layout for scoreboard equipment. Verify dimensions by field measurements.
- C. Verify mounting structure is capable of supporting the scoreboard's and/or timing displays weight and windload in addition to the auxiliary equipment.
- D. Installation may proceed within acceptable weather conditions.
- E. All job conditions in Section 31 22 01 apply.

1.07 QUALITY ASSURANCE

- A. For outdoor use.
- B. Source Limitations: Obtain each type of scoring or related equipment through one source from a single manufacturer.
- C. Scoreboard manufacturer must design the modules and digits, design and build the circuitry and circuit boards, take the core components (discreet LEDs, transistors, resistors, circuit boards, power supplies, etc.), assemble and integrate the units, calibrate for uniformity, and assemble into the mounting structure in facility(s) located within the US.
- D. All Scoreboards and associated identification panels must be engineered to meet or exceed NYS building code 90MPH wind speed requirements. Testing data must be provided with submittals.
- D. All internal scoreboard drivers must be identical and interchangeable between all specified scoreboards.
- F. ETL listed to UL Standards 48 and 1433

- G. NEC compliant
- H. FCC compliant
- I. ETLIC listed to CAN/CSA 22.2 #207
- J. Installer's qualification: Business familiar in the installation of systems similar in complexity to those essential for this project; and fulfillment of the following:
 - 1. At least (5) five years' experience with systems of the specified types and products included.
 - 2. Retain a fully staffed and equipped service facility within 100 miles of project.
 - 3. Installer to be factory educated in the installation and maintenance of any digital signal processed based control systems.
 - 4. At the request of the owner, the Installer must demonstrate that he has:
 - a. Sufficient plant and equipment to complete the work within the agreed timetable
 - b. Sufficient staff with commensurate technical experience
 - c. Appropriate financial status to meet the obligations of the work

1.08 WARRANTY

- A. Provide five (5) years of factory warranty on permanently mounted scoreboards and LED message displays, including wireless control equipment.
- B. Provide one (1) year warranty for batteries, battery-packs, battery recharging equipment, solar panels, pushbuttons, speakers, test meters, data cables and handheld control consoles/units.
- C. Provide 10 years of guaranteed availability of original parts for all equipment from the scoreboard manufacturer.
- D. Provide toll-free service coordination
- E. Provide technical phone support during school business hours

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Daktronics, Inc., 331 32nd Avenue, P.O. Box 5128, Brookings, South Dakota 57006-5128, or Architect approved equal.
- B. FB-2022 single-sided football/track scoreboard displays period or race time to 99:59.9, HOME and GUEST scores to 99, and DOWN/TO GO/BALL ON/QTR (quarter) information. T.O.L. (time outs left) to nine are optional. Arrows indicate possession. Scoreboard comes standard with track captions on changeable panels. During the last minute of the period, the clock displays time to 1/10 of a second.

- C. Daktronics MS-2012 single-sided multisport scoreboard displays PLAYER number to 99 and PENALTY time to 9:59 for two players on both teams. The MS-2004 is designed to complement 25' (7.62 m) wide scoreboards for lacrosse, field hockey or any other sport with players and penalties.
- D. Daktronics TI-2015 single-sided timing display can be configured to count up or down from any preset number from 0 to 99.

1.02 MULTI-SPORT SCOREBOARD

A. GENERAL INFORMATION

- 1. Dimensions: 8'-0" (2.44 m) high, 25'-0" (7.62 m) wide, 0'-8" (203 mm) deep
- 2. Base weight: 820 lb
- 3. Base power requirement: 670 W
- 4. Color: more than 150 colors to choose from

B. CONSTRUCTION

- 1. Alcoa aluminum alloy 5052 construction
- 2. To avoid oil canning or waves in the face of the aluminum, no mechanical fasteners (screws, rivets or welds) shall be used to attach the face to the scoreboard body frame. Commercial sign tape shall be used to cover 100% coverage on all face attachment points.
- 3. The scoreboard cabinet structure shall not have any internal vertical or horizontal members spaced more than 42" O.C.
- 4. The cabinet shall be one continuous structure without any vertical seams to be stitched together.
- 5. Scoreboard shall be able to be mounted to two (2) vertical columns and a have documented engineering data reflecting the ability of the cabinet to withstand wind pressure up to 72 lbs./sq. ft. with vertical I-beam spacing up to 16 ft. O.C.
- 6. Scoreboard face, back and perimeter: 0.063" thick
- 7. Scoreboard top and bottom shall be a minimum of 0.125" thick extruded aluminum for added strength and to eliminated sagging
- 8. Digit faceplates: 0.063" thick
- 9. All scoreboard, decorative truss and school identification panel attachments to the beam structure shall be fastened only to the front flange of the beam to allow for attachment of additional panels to the back flange of the beam.
- 10. Each scoreboard, decorative truss and school identification cabinet shall require no more than one set of mounting clamps per vertical column at the top and bottom of each cabinet.
- 11. Mounting shall not require any drilling, welding or fastening hardware that penetrates the scoreboard, decorative truss and school identification cabinets

C. DIGITS AND DRIVERS

- 1. TS AlInGaP Light Emitting Diodes (LEDs)
- 2. Seven bar segments per digit
- 3. Digit color: White
- 4. PanaView® LED 140 degree digit technology. LED elements must protrude from scoreboard face and should not include any plastic, reflective protective face cover
- 5. All components of each LED digit shall be encapsulated in a minimum of 1/8" thick, potting material, front and back allowing the entire unit to be 100% waterproof

6. Digit drivers and circuit boards within the scoreboard must be encapsulated in a minimum of 1/8" thick, potting material, front and back allowing the entire unit to be 100% waterproof
7. Clock digits: 30" high
8. HOME, GUEST, DOWN, TO GO, BALL ON, and QTR digits: 24" (610 mm) high
9. Individual digit panels are fastened with a maximum of four screws for easy access and quick removal. Rivets are not an acceptable fastening method. Lexan covers shall not be used.

D. CAPTIONS

1. Programmable white LED electronic HOME and GUEST, DOWN, TO GO, BALL ON, and QUARTER captions: 10" high

E. ADDITIONAL REQUIRED EQUIPMENT

1. Vinyl scoreboard striping around the scoreboard to create a continuous border.
2. 120 volt horn, , 0.75A, 60HZ, 100 DB of sound @10ft, 110 DB of sound @1 meter, weatherproof
3. Programmable Team Name Message Centers (TNMCs) with white LEDs
4. Dual purpose 2.4 GHz spread spectrum radio control receiver mounted within the scoreboard cabinet to allow for control of scoreboard, wirelessly via mobile cell phone device and from the press box via the AllSport Controller and the Dak Score cell phone App control systems
5. Daktronics IDA-1001-25 decorative truss (4' x25'-0") above the scoreboard with backlit (illuminated) school identification lettering or logo.
 - Must be constructed of 100% aluminum
 - Aluminum members shall be a combination of 2" x 2" and 3" x 3" square tubes and angles
 - Letters and logos must be a minimum of 36" in height and internally illuminated
 - To maintain consistency in paint color and longevity, all truss painting shall be completed by the same manufacturer as the scoreboard, video board and school identification panels.

2.03 MULTI-SPORT SCOREBOARD – PLAYER PENALTY SECTION

A. General information

1. Dimensions: 5'-0" (1.52 m) high, 25'-0" (7.62 m) wide, 0'-8" (203 mm) deep
2. Base weight: 475 lb
3. Base power requirement: 560 W
4. Color: more than 150 colors to choose from

B. Construction

1. Alcoa aluminum alloy 5052 construction
2. To avoid oil canning or waves in the face of the aluminum, no mechanical fasteners (screws, rivets or welds) shall be used to attach the face to the scoreboard body frame. Commercial sign tape shall be used to cover 100% coverage on all face attachment points.
3. The scoreboard cabinet structure shall not have any internal vertical or horizontal members spaced more than 42" O.C.
4. The cabinet shall be one continuous structure without any vertical seams to be stitched together.
5. Scoreboard shall be able to be mounted to two (2) vertical columns and a have documented engineering data reflecting the ability of the cabinet to withstand wind pressure up to 72 lbs./sq. ft. with vertical I-beam spacing up to 16 ft. O.C.
6. Scoreboard face, back and perimeter: 0.063" thick

7. Scoreboard top and bottom shall be a minimum of 0.125" thick extruded aluminum for added strength and to eliminated sagging
8. Digit faceplates: 0.063" thick
9. All scoreboard, decorative truss and school identification panel attachments to the beam structure shall be fastened only to the front flange of the beam to allow for attachment of additional panels to the back flange of the beam.
10. Each scoreboard, video display, decorative truss and school identification cabinet shall require no more than one set of mounting clamps per vertical column at the top and bottom of each cabinet.
11. Mounting shall not require any drilling, welding or fastening hardware that penetrates the scoreboard, video display, decorative truss and school identification cabinets

C. Digits and drivers

1. TS AlInGaP Light Emitting Diodes (LEDs)
2. Seven bar segments per digit
3. Digit color: White
4. PanaView® LED 140 degree digit technology. LED elements must protrude from scoreboard face and should not include any plastic, reflective protective face cover
5. All components of each LED digit shall be encapsulated in a minimum of 1/8" thick, potting material, front and back allowing the entire unit to be 100% waterproof
6. Digit drivers and circuit boards within the scoreboard must be encapsulated in a minimum of 1/8" thick, potting material, front and back allowing the entire unit to be 100% waterproof
7. PLAYER and PENALTY digits: 18" (457 mm) high
8. Individual digit panels are fastened with a maximum of four screws for easy access and quick removal. Rivets are not an acceptable fastening method. Lexan covers shall not be used.

D. Captions

1. Vinyl applied directly to scoreboard face
2. PLAYER and PENALTY captions: 9" (229 mm) high

2.04 TIMING DISPLAY(S) (1 PAIR)

A. General information

1. Dimensions: 2'-4" high, 3'-4" wide, 0'-8" deep
2. Weight: 36 lb (29 kg)
3. Power requirement: 75 W
4. Color: semi-gloss black

B. Construction

1. Alcoa aluminum alloy 5052 construction
2. To avoid oil canning or waves in the face of the aluminum, no mechanical fasteners (screws, rivets or welds shall be used to attach the face to the scoreboard body frame. Commercial sign tape shall be used to cover 100% coverage on all face attachment points.
3. Display back, face, and perimeter: 0.063" (1.60 mm) thick

C. Digits and drivers

1. TS AlInGaP Light Emitting Diodes (LEDs)
2. Seven bar segments per digit
3. Digit color: Red
4. PanaView® LED 140 degree digit technology. LED elements must protrude from scoreboard face and should not include any plastic, reflective protective face cover
5. All components of each LED digit shall be encapsulated in a minimum of 1/8" thick, potting material, front and back allowing the entire unit to be 100% waterproof

6. Digit driver must be encapsulated in a minimum of 1/8" thick, potting material, front and back allowing the entire unit to be 100% waterproof
 7. Clock digits: 30" (762 mm) high
- D. Horn
1. Shall include a horn within each play clock cabinet
- E. Additional Required Equipment
1. Individual digit protective screens
 2. Dual purpose 2.4 GHz spread spectrum radio control receiver mounted within the scoreboard cabinet to allow for control of scoreboard, wirelessly via mobile cell phone device and from the press box via the AllSport Pro iPad control system

2.05 SCORING CONSOLE

- A. Consoles shall be an All Sport® 5010 controller and MX1 mobile scoring application from smartphone.
- B. Capable of scoring football, lacrosse, soccer and field hockey through the use of keyboard inserts
- C. Controls multiple scoreboards and displays, including other compatible displays currently owned by customer
- D. Full Feature AS-5010 Console includes:
1. Capability to operate the fixed-digit portion of the scoreboard system as a standalone system, from the press box.
 2. Maximum power requirement of 5 watts
 3. Ability to recall clock, score, and period information if power is lost
 4. A rugged aluminum enclosure to house electronics
 5. A sealed membrane water-resistant keyboard
 6. A 32-character liquid crystal prompting display to verify entries and recall information currently displayed
 7. A 6' (1829 mm) power cord to plug into a standard grounded 120 V AC outlet
 8. A 20' (6096 mm) control cable to connect to the control receptacle junction box
 9. A practice timer mode
 - a. Can sound the horn at the end of each segment
 - b. Has 99 programmable segments
 - c. Displays the segment number and segment length
 - d. Has a programmable interval time
 10. Carrying case for console
 11. 2.4 GHz spread spectrum radio system with frequency hopping technology and 64 non-interfering channels; system includes a transmitter installed inside the console enclosure and a receiver installed inside the scoreboard
 - a. Encapsulated Protective Molded PVC external antenna enclosure affixed to control console.
 12. AllSportPro Ipad allows all functions of scoreboard to be controlled by portable tablet controller
 13. MX-1 Mobile Scoring Control
 - a. Portable control shall allow function of the scoreboard including electronic changeable captions from any location on site (i.e. bleachers, playing field, etc.).
 - b. Controls multiple scoreboards and displays, including other compatible displays currently owned by customer
 - c. Outdoor weather sealed mounting enclosure.
 - d. 2.4 GHz spread spectrum radio system with frequency hopping technology and 64 non-interfering channels; system includes a transmitter installed inside the console enclosure and a receiver installed inside the scoreboard
 - e. Mobile app shall be downloadable to any Apple or Android phone or tablet.
 - a. Shall be upgradeable to accommodate future video display control options to allow the fixed digit portion of future video board to be controlled on a single device.

2.06 STRUCTURAL SUPPORT - FOR SCOREBOARD AND TIMING DISPLAY

- A. Vertical supports shall be ASTM-36 steel I-beams.
- B. Footings shall be sized per manufacturer's NYS structural engineers' recommendation and utilize 4000 psi mix concrete as specified in Section 32 13 01.
- C. Columns shall be factory galvanized and painted black with two coats of enamel paint capable of adhering to galvanized steel. Field touchup as directed by the Architect. Provide one unopened can of touchup paint for owner.

PART 3 - EXECUTION

3.01 INSTALL STEEL COLUMNS

- A. Install steel columns as shown on the drawings and per manufacturer's recommendations.

3.02 EXAMINATION

- A. Verify that mounting structure is ready to receive scoreboard. Verify that placement of conduit and junction boxes are as specified and indicated in plans and shop drawings. Verify concrete has cured adequately according to specifications.

3.03 INSTALLATION

- A. All power and control cables to scoreboards, audio system and displays will be routed in conduit, power to the scoreboards/displays as well as raceways by the Electrical Contractor.
- B. Install scoreboards and exterior displays to beams in location detailed and in accordance with manufacturer's instructions. Verify unit is plumb and level.
- C. All scoreboard and video display attachments to the beam structure shall be fastened only to the front flange of the beam to allow for attachment of additional panels to the back flange of the beam.
- D. Each scoreboard and video display cabinet shall require no more than one set of mounting clamps per vertical column at the top and bottom of each cabinet.
- E. Mounting shall not require any drilling, welding or fastening hardware that penetrates the scoreboard or video board cabinets.
- F. Manufacturer's representative to provide and install structural support steel in accordance to the equipment ordered.

3.04 INSTALLATION - CONTROL CENTER

- A. Provide boxes, cover plates and jacks in locations per plans.
- B. Test connect control unit to all jacks and check for proper operation of control unit, scoreboard and all features. Leave control unit in carrying case and other loose accessories with owner's designated representative.
- C. Verify earth ground does not exceed 15 ohms.

3.05 CLEAN UP

- A. During the contract and at intervals as directed by the Architect and as scoreboard and timing displays are completed, clear the site of all extraneous concrete, gravel, fence material or debris. Leave the site in a clean, safe, well-draining, neat condition.

END OF SECTION

SECTION 32 30 06

EXTERIOR ELEVATED ALUMINUM BLEACHERS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. This section includes complete services to provide an elevated aluminum bleacher system of size and capacity, and with features indicated on the drawings.
- B. Complete Scope of Work in this bid package includes but is not limited to the following:
 - 1. AISC certified steel fabrication
 - 2. Steel Understructure Designed with an L/200 Serviceability Criteria
 - 3. Galvanized structural steel
 - 4. Fully Closed Aluminum Deck System
 - 5. Enhanced slip and stain resistant deck finish
 - 6. Aluminum Risers
 - 7. NYS Certified Modular Press Box
 - 8. Concrete Foundations
 - 9. Clean Up
- C. Provide all labor, materials, equipment, and services required to accomplish work in accordance with the drawings and specifications. Provide all design, engineering, freight, installation, supervision, state approvals, and inspections.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 31 12 01 - Site Preparation
- B. Section 31 22 01 - Site Earthwork
- C. Section 32 13 01 - Site Concrete Work
- D. Section 32 30 07 - Press Box

1.03 REFERENCES/APPLICABLE CODES

All design, materials, and workmanship shall be in accordance with the following, and the most stringent:

- A. NY State Building Code (NYCRR), Latest Edition
- B. NFPA 101 and 102, Latest Addition
- C. AISC Steel Construction Manual, Latest Edition
- D. International Building Code (IBC), Latest Edition or State Version with Amendments
- E. ICC-300-2017 (Standards for bleachers, folding, and telescopic seating and grandstands)
- F. Aluminum Association Design Manual 2010
- G. ASTM E985

- H. ANSI/AWS D1.2 Structural Welding Code
- I. Americans with Disabilities Act
- J. ACI 318-05

1.04 DESIGN CRITERIA

- A. All material and workmanship shall be in accordance with the applicable state building code/IBC current edition and NFPA.
- B. Design Loads:

Dead Load	10 psf
Live Load	100 psf gross horizontal projection. All stringers shall be limited to L/200 for maximum vertical live load deflection
Live Load Seat & Tread Plank	120 psf
Wind Speed	Design per local wind speeds & building codes
Sway Load	24 plf per row parallel to seatboards
Sway Load	10 plf per row perpendicular to seatboards
Seismic Load	Design per local seismic conditions
Guardrail Loads	50 plf distributed or 100 lbs. concentrated load applied in any direction
- C. Serviceability Requirements: Deflection shall be limited to 1/200 of the span for all structural members.
- D. Foundation Design: Foundations shall be designed for bearing, overturning, and sliding for the following load cases as well as all applicable load cases in the building code using an allowable stress design.
 - 1. 1.0 DL + 1.0 LL + SWAY
 - 2. 0.6 DL + 1.0 WL
 - 3. 1.0 DL + 0.75 WL + 0.75 LL
- E. Soil bearing capacity to be verified by Contractor prior to placement of footings. Foundation sizes if shown on drawings will not be reduced under any circumstances.

1.05 SUBMITTALS

- A. Fabricator AISC Certificate of compliance with the Standard for Steel Building Structures as outlined in 1.07 of this specification.
- B. Product Certificate: Prepare written statement on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- C. Experience requirements listed in 1.07.
- D. Shop Drawings: Complete detailed drawings prepared, signed, and sealed by a Registered Professional Engineer (P.E.) licensed in the State of New York. Include:
 - 1. Detailed and dimensioned plans.

2. Seating plan indicating aisles, walkways, seating sections and exits and showing exit calculations using appropriate tables and requirements of the New York State Building Code.
 3. Sections and details showing complete methods of assembly and anchorage.
 4. Footings and foundation sizes and types and relationships to finish grade in compliance with construction documents. Exposed portions of foundations, pier height and top elevations shall be subject to customer approval.
 5. Engineering calculations.
 6. Minimum sizes for structural steel and foundations are shown on bid document drawings, in order to establish an equal bidding opportunity for all participants. Reduction in minimum sizes of structural steel will not be allowed.
- E. Qualifications of NYS Professional Engineer who seals the shop drawings and calculations.
- F. Samples for verification of product and color to include 3' section of deck assembly with interlocking riser in specified dimensions and finishes and 3' long seat board with mounting bracket.

1.06 JOB CONDITIONS

- A. All job conditions in Section 31 12 01 apply.
- B. A qualified representative of the grandstand manufacturer must be onsite at all times during installation of the grandstand.
- C. Verify site location of bleachers and locate all underground utilities. Visit site as described in Section 31 12 01.
- D. NY State Professional Engineer (PE) hired by the bleachers supplier will determine soil bearing capacity of on site soils from provided soil boring, pit information, and additional testing as the PE deems necessary. PE is solely responsible for design interpretations and subsequent design of the bleachers.
- E. The contract documents provided by the Owner include existing and proposed grades.
- F. The contract documents indicate grades, approximate pier locations and walkways to meet the side stairs for the specified product. If a product other than as specified is submitted, the Contractor shall also submit a revised plan indicating grades and walkway locations relating to the stairs of the proposed product for the Architect's approval.

1.07 QUALITY ASSURANCE

- A. AISC Certification: All structural steel shall be fabricated in an American Institute of Steel Construction (AISC) certified plant that is certified "STD" at the time of the bid. The manufacturer shall be listed on AISC's website as a certified fabricator.

- B. Experience: Manufacturer of grandstand system shall have a minimum of five (5) years' experience in fabrication of grandstand structures and shall, provide references to five (5) successful projects of similar size and project specific requirements within New York State. Submit to Architect for approval
- C. Installation: Installation shall be performed by factory trained and certified representatives of the grandstand manufacturer. Installer shall have completed at least three (3) installations of similar size in the past two (2) years. Provide documentation to support individual's qualifications.
- D. Source Quality Control: Mill Test Certification.
- E. Provide test reports certifying that the bleachers have been inspected and installed in accordance with the contract documents. This shall be performed by an independent testing agency hired by the Contractor. The testing agency's representative shall be either a NYS licensed Professional Engineer or working under the direct supervision of a NYS licensed Professional Engineer. The inspection shall include examination of:
 - 1. High strength bolted connections for general conformance with the AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts". The connections shall be examined to confirm a "snug tight" condition with all plies in intimate contact.
 - 2. General conformance with the AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts" to confirm that all nuts are "run down"
 - 3. Confirmation of non-slip finish installation.

1.08 SUBSTITUTIONS

- A. Substitutions: If a product is being submitted as a substitution to the specified product, then the Prime Contractor shall submit and request a product material substitution with his/her bid. The Prime Contractor shall at a minimum provide the following for review by the Architect and Owner:
 - 1. All submittals as specified herein.
 - 2. Product comparison
 - 3. Cost information (including proposal of change in Contract Sum)
 - 4. Contractor's certification that proposed substitution complies with requirements in the Contract Documents.
 - 5. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

NOTE: Delays caused by required submittals due to noncompliance with the specification shall not extend any milestone date in the contract. The contractor is responsible for complying with all aspects of this specification.

1.09 WARRANTY

- A. All products shall carry, after proper erection, and under normal use for the type of structure, a five (5) year warranty against all defects in materials and workmanship from the date of substantial completion.
- B. In addition, all aluminum plank extrusions shall be covered by a three (3) year warranty against deterioration of anodized finish or loss of structural strength due specifically to constant exposure to changing weather and environmental conditions.

PART 2 - PRODUCTS

2.01 MANUFACTURER(S)

- A. E&D Specialty Stands, Inc. North Collins, NY (800) 525-8515; Dant Clayton Corporation, (800) 467-3655; Sturdi-Steel (800) 433-3116 or Architect approved equal. Listing as acceptable manufacturer does not remove responsibility to meet specifications.

2.02 PRODUCT COMPONENTS

- A. Product Description:
 - 1. Horizontal Beam Design: Vertical columns placed 18'-0" on center laterally. All horizontal beams are wide flange beams. Transverse bays are free of cross bracing the total length of the grandstand.
 - 2. Stringers: Stringers are wide flange beams with steel angle rise and depth fabrication and are placed 6'-0" on center.
 - 3. All steel shall be sized to support the most conservative of the loads in the table above, and the loads in the state building code. If sizes are shown in the drawings, they shall not be reduced for any reason.
- B. Front Walkway:
 - 1. Walkway width 6 feet 2 inches.
 - 2. Elevated 4 feet 1 inches above grade front of grandstand.
- C. Fully Closed Decking System:
 - 1. Rise per row 13 inches, depth per row 26 inches and as shown on the drawings
 - 2. Plank Arrangement:
 - a. CHANNEL INTERLOCK DECK (CI). The planking shall be maintenance free, corrosion resistant all aluminum deck. There will be no gaps between the longitudinal joints of the planking. The deck extrusions shall have a minimum actual vertical support rib height of 1.75" and a wall

thickness of 0.080". All deck extrusions shall mate longitudinally within the exterior vertical rib of the entire extrusion length to create a positive male/female tongue and groove connection for the elimination of independent individual deck member flex. The decking is designed for strength and rigidity to prevent an oil-canning effect in the decking material. The tread surface shall have a non-slip anti-skid fluted design for safety and be designed for a concealed fastening system to the understructure.

- b. Attachment to Decking: These extrusions shall be such that the attachment of the seat brackets, step brackets, mid-aisle rails and all other components that attach at the tread-riser is accomplished without deck penetrations. No through bolting or drilling of the aluminum tread-riser system shall be permitted. Only in areas where there is not a nose or heel channels will thru bolting be acceptable. The system shall allow for seat and aisle reconfiguration at any time without evidence of its previous configuration.
 - c. Walking Surface Treatment (Traction Coating): All aluminum intended as a walking surface, including walkways, aisles, walking surface in seating sections, stairs, ramps, platforms, handicap areas, and landings will exhibit a factory applied slip resistant surface treatment intended to minimize the effects of wet conditions for pedestrians' safety. This surface treatment will increase the slip resistance of mill finish aluminum in all directions of travel, including parallel to the seating, to achieve 0.8 coefficient of friction (slip resistance) under wet conditions as well as dry conditions. The preferred method for this slip and stain resistance is an electrostatically applied thermobonded finish.
 - d. Riser Planks: The riser is to be an extrusion of 6063-T6 aluminum alloy 0.078" wall thickness that has a male ridge running continuous at the top edge so designed that it will interlock into the front bottom of the nosing extrusion on the tread. The riser is to be of sufficient overall height to adequately lap the vertical projection of the back and lower tread extrusion.
3. Riser Board Finish:
- a. Finish: Clear anodized finish: 204R1, AA-M10C22A31, Class II.
4. Riser Plank Front Closure:
- a. Material and finish to match bleacher risers.
 - b. Closure to cover the field side of the bleacher, stair, and ramp.
 - c. Finish: Clear anodized finish: 204R1, AA-M10C22A31, Class II.
5. Seating:

- a. 2 x 10 SEAT BOARD: The seat board shall be maintenance free, corrosion resistant all aluminum plank. The seat board extrusions shall have four vertical support ribs at a minimum actual height of 1.75" and a wall thickness of 0.08".
6. Seat Board Finish:
- a. All Riser boards shall have a color powder coat finish in color selected by architect from manufacturer's standard color choices.
7. Guardrails:
- a. Pipe and Fence System (Vinyl Fence): Furnished on sides of the bleacher including stairs, ramps, vomitories and landings. The railing system shall be designed to meet all applicable codes. Rails shall be not less than 42" vertically above the leading edge of the seat board surface at the back and sides of the bleacher. Rails shall not be less than 42" above the elevated front footrests. The railings are to be 1 5/8" O.D. anodized aluminum pipe with end plugs at ends of straight runs and/ or elbows at corners. They are secured to angle rail posts with galvanized rail clamps and fasteners. Included on all sides of the bleacher will be 2" x 6-gauge Black Vinyl Coated chain link fencing fastened in place with aluminum ties.
7. Means of Egress:
- a. Stairs: Shall be provided per applicable codes and/or architects drawings. Stairs shall have a maximum rise of 7" and a minimum run of 11" with a 1" contrasting nose (black) to delineate the leading edge of each step. Risers shall be provided to fully close the space between the stair treads. The stair guardrails shall be 42" above the leading edge of the treads. Handrails shall extend at least 12" beyond the top and bottom of the stair segment and shall be parallel with the floor or ground surface. The clear space between the handrail and the guardrail shall be 1-1/2" minimum. Gripping surfaces shall be continuous. Top of handrail gripping surfaces shall be mounted between 34" and 38" above the leading edge of the treads. Ends of handrails shall be either rounded or returned smoothly to floor, wall, or post. Handrails shall not rotate within their fittings.
 - b. Ramps: Shall be provided per applicable codes and/or architects drawings. The maximum slope of a ramp shall be 1:12. The maximum rise for any run shall be 30". The minimum clear width of a ramp shall be 36". Ramps shall have level landings at the bottom and top of each run. The landing shall be at least as wide as the ramp leading to it. The landing length shall be a minimum of 60" clear. If ramps change direction at landings, the minimum landing size shall be 60" by 60". Handrails shall be provided along both sides of ramp segments. The inside handrail on

switchback or dogleg ramps shall always be continuous. If handrails are not continuous, they shall extend at least 12" beyond the top and bottom of the ramp segment and shall be parallel with the floor or ground surface. The clear space between the handrail and the guardrail shall be 1-1/2" minimum. Gripping surfaces shall be continuous. Top of handrail gripping surfaces shall be mounted between 34" and 38" above ramp surfaces. Ends of handrails shall be either rounded or returned smoothly to floor, wall, or post. Handrails shall not rotate within their fittings.

- c. Aisles: Shall be provided per applicable codes and/or architects drawings. Aisles with seating on both sides shall have a 36" high, 1 5/8" O.D. anodized aluminum pipe handrail with an intermediate rail at approximately 22" above tread. Anodized aluminum handrails with rounded ends are discontinuous to allow access to seating through a space 22" (min.) to 36" (max.). Intermediate steps shall provide equal rise and run throughout aisle. Each shall have aisle nosing with black powder coat finish and riser closure with finish to match the grandstand risers.

8. Handicap Provisions:

- a. Handicapped seating shall be provided per applicable codes and the (Americans with Disabilities Act) for wheelchair accessibility and/or architects' drawings. All handicapped seating is to have a companion seat adjacent to them. Wheelchair pockets inset into the front rows of seating will be enclosed on all three sides with no exposed vertical rise allowed.

2.03 MATERIALS

A. Structural Steel:

- 1. All detailing, fabrication, and erection shall be completed in accordance with the AISC Steel Construction Manual 13th Edition. All fabrication shall be completed in an AISC certified facility as described in Paragraph 1.8 A.
- 2. Structural Steel shall be ASTM A572 multi-certified grade 50. Miscellaneous steel shall be ASTM A36.
- 3. Bolts & Nuts: All bolts 5/8" diameter and larger shall meet ASTM A325. All bolts 1/2" and smaller shall meet ASTM A307.
- 4. All welds shall conform to ANSI/AWS D1.1. Electrodes shall be E70xx

B. Aluminum:

- 1. All footboards & seatboards shall consist of 6063-T6 aluminum alloy with minimum yield strength of 25 ksi.

2. All straight grab & hand rails shall consist of 6061-T6 aluminum alloy with minimum yield strength of 35 ksi.
3. All bent grab & hand rails shall consist of 6061-T4 aluminum alloy with minimum yield strength of 21 ksi.

2.04 FINISHES

A. Structural Steel:

1. All structural steel shall be galvanized.
2. All structural steel fasteners shall be galvanized.

B. Aluminum:

1. Walking Surface Requirement: All aluminum footboards shall have an enhanced stain resistant and slip resistant thermobonded finish at all locations intended for use as a walking surface.
 - a. This finish shall be produced by the bleacher manufacturer in addition to the mill extrusion process.
 - b. This surface finish shall prevent oxidation staining. Oxidation staining prior to substantial completion shall be grounds for product replacement at the manufacturer's expense.
 - c. This surface finish shall exhibit enhanced slip resistance beyond the mill extrusion process, resulting in an improved coefficient of friction under wet conditions in all directions of travel.
 - d. Untreated mill finish aluminum with raised extruded "flutes" or "ribs" does not meet this requirement.
2. All seat boards shall have a powdercoat finish in color selected by owner from manufacturer's standard color choices.
3. Powder coat system shall meet or exceed the following test requirements:
 - a. Direct Impact Resistance: ASTM D 2794-93, up to 140 in.-lbs.
 - b. Flexibility: ASTM D 522-93, Method B, 100% Pass
 - c. Pencil Hardness: ASTM D 3363-93a, 3H-4H
 - d. Crosshatch Adhesion: ASTM D 3359-97, Method B, 5B, 100% Pass
 - e. Salt Spray Resistance: ASTM B 117, plus 1,000 hours
 - f. Humidity Resistance: ASTM D 2247, plus 1,000 hours
4. All Riser boards shall have a clear anodized finish.
5. All hand and Grab Rails shall be clear anodized

2.05 ACCESSORIES

- A. Hardware:
 - 1. High Strength Bolts and Nuts – ASTM A-3125 steel. Hot dipped galvanized.
 - 2. Ordinary Bolts and Nuts – ASTM A-307. Hot dipped galvanized.
 - 3. Hold-Down Clip Assemblies – Aluminum alloy 6063-T6.
 - 4. Screws shall be 302 stainless steel with Ruspert coating.

- B. End Caps:
 - 1. Tread Planks: single planks and multiple planks shall be capped with a one-piece end cap. Extruded aluminum 6063-T6. Clear anodized finish: 204R1, AA-M10C22A31, Class II. Attached with stainless steel screws.
 - 2. Seat Planks: End cap should encapsulate the end of the plank leaving no part of the cut end exposed. The end cap shall be made of stamped aluminum with smooth edges and Clear anodized finish: 204R1, AA-M10C22A31, Class II. Attached with stainless steel screws.

- C. Joint Sleeve Assembly: To be inserted in flat plank to maintain true alignment in joining two plank pieces.

- D. Hand Railing: Extruded aluminum alloy, 6063-T6 clear anodized 204R1, AA-M10C22A31, Class II.

- E. Aisle Nose and Stair Nose: Aluminum alloy, 6063-T6, non-skid black powder coated finish or other paint system meeting AAMA 603.8-92 specifications with a hardness rating of 2H.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. Examine all soils and footings to ensure solid and secure footings.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Install concrete footings at all locations noted on the drawings and allow sufficient cure time prior to installation.
- C. Grade surrounding landscape prior to installation of benches or grandstands.
- D. Prepare surfaces using the methods recommended to achieve the best result based on project conditions.

3.03 CONCRETE FOUNDATIONS AND PIERS

- A. Design of foundations shall be performed by manufacturer's engineer. Engineer must be registered in the state of New York and shall provide signed and sealed calculations along with the submittal drawings. Design shall comply with IBC and all local codes. All concrete work and materials shall be in accordance with ACI 301 and ACI 318. Top of pier elevation at rear column line to be 3'-4" above grade. Footings for the grandstand shall be designed to provide a sufficient bearing area to support the total live and dead loads of the grandstand without exceeding the allowable soil bearing pressure.
- B. Design and depth of footings shall be determined from the geotechnical report indicating local soil conditions.
- C. Reinforcing steel shall be in accordance with ASTM A615 and Concrete Steel Reinforcing Institute (CSRI) manual of standard practice. Bars shall be 60 grade.
- D. Cast in place concrete shall a minimum compressive strength of 4,000 psi at 28 days.
- E. Anchor bolts to be embedded in cast in place concrete.

3.04 INSTALLATION

- A. Installation shall be performed by manufacturers certified installation crew. Installer shall be experienced in similar installations to that indicated for this project.
- B. Follow all current application requirements for installation under conditions specific to the project. Complete installation as per approved shop drawings and manufacturer's instructions.
- C. Where manufacturer's requirements and building codes are in direct conflict, the more restrictive method of application shall prevail.
- D. After installation, unit shall be inspected by Contractor for proper alignment and function. Bleacher manufacturer shall provide written letter stating bleachers are installed properly.

3.05 PROTECTION AND CLEAN UP

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.
- C. Prior to final inspection, clean all surfaces in accordance with manufacturers' recommendations.
- D. Remove and dispose of all construction debris.

END OF SECTION

SECTION 32 30 07

PRESS BOX

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. The extent of the press box is shown on the drawings. Make all transition connections smooth and in a neat workmanlike condition.
- B. Press box work includes, but is not limited to, the following:
 - 1. Concrete foundations
 - 2. Steel understructure
 - 3. NYS Certified Modular Press Box
 - 4. Clean Up
- C. Access for press box shall be by means of bleacher stairs meeting press box landings as shown on drawings. Provide secure connection.
- D. Provide all materials, labor, equipment, and services required to accomplish all related work in accordance with the drawings and specifications. Provide all design, engineering, freight, installation, supervision, state approvals, and inspections.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 31 12 01 - Site Preparation
- B. Section 31 22 01 - Site Earthwork
- C. Section 32 13 01 - Site Concrete Work
- D. Section 32 30 06 – Exterior Elevated Aluminum Bleachers
- E. Electrical

1.03 REFERENCES/APPLICABLE CODES

All design, materials, and workmanship shall be in accordance with the following:

- A. NY State Building Code (NYCRR), Latest Edition
- B. NFPA 101 and 102, Latest Edition
- C. International Building Code (IBC)

1.04 DESIGN CRITERIA

- A. Design Loads:
 - Roofing: 100 psf live load

25 psf dead load
50 psf snow load

Floors: 100 psf live load
20 psf dead load

Horizontal Wind Speed: 90 mph, Exposure C
Vertical Wind: 19 psf Main Force Resisting System

Seismic Design Category: B
Seismic Use Group: I
Spectral Response Coefficients: $SD_s=0.222g$
 $SD_1=0.129g$
Occupancy Group: A-5 Construction Type: 5-A

- C. General: The structure shall be properly braced for wind and construction loads until all structural elements are secured.

1.05 SUBMITTALS

- A. Bidders must comply with the following:
1. Schedule of Work Experience, including names of contacts and phone numbers; ten (10) jobs minimum within the last five (5) years.
 2. List of three (3) similar jobs within the past two (2) years within New York State. Provide all contact information.
 3. Resume including Corporate Officers, Sales Representatives, Technical Advisor, Project Manager, and Job Site Superintendent.
 4. Project schedule, including phasing with other trades and designation for all tasks, milestone dates for drawing submittal, fabrication time, key material delivery dates and designated dates of installation.
 5. The manufacturer's Engineer shall certify that he has designed the structures in conformance with these specifications and the governing codes applicable at the time the work was prepared and that the design conforms to the prevailing standards of practice. This shall include, but not be limited to, the structural and electrical portions of the press box. These calculations shall bear the seal and signature of a licensed New York State Professional Engineer.
 6. Materials Certificates: Provide five (5) copies for each material from material producer, stamped as checked and approved by the Contractor before submittal to the Architect. Each material shall be certified by an approved independent testing laboratory as complying with or exceeding the specified requirements. Submit certificates to Architect a minimum of two (2) weeks prior to installation.

7. Design Calculations: Design calculations for the press box shall be submitted for review by the Architect. The calculations shall bear the seal and signature of a licensed New York State professional engineer and shall present an analysis that will indicate the structural members are of sufficient strength to support the design loads. This analysis shall also indicate that the structural members are able to resist deformations caused by such design loads to which they may be subjected, without exceeding the allowable stresses of the materials. These calculations shall also note additional structural members needed.
8. Shop drawings shall include interior and exterior elevations, and also any needed structural improvements to the bleachers system to support and anchor the press box. Finish colors and materials for interior and exterior use are to be labeled on drawings, and samples are to be provided for owner approval.

1.06 SITE REPRESENTATION

A qualified representative of the pressbox manufacturer must be onsite at all times during installation of the press box.

1.07 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in modular building construction with experience in manufacturing press boxes.
- B. Engineer qualifications: The press box design, construction, and installation, shall be approved by the Contractor's registered NYS licensed professional engineer.
- C. Codes and Standards: All design, fabrication and construction shall comply with the following, or the most current editions:
 - 2017 National Electric Code
 - State Energy Conservation Construction Code
 - New York State Uniform Fire Prevention and Building Code, Title 19, Chapter XXXIII (Subchapter A) of New York Codes, Rules and Regulations
 - 2016 NFPA 101 and 102, or latest edition AISC Manual, 15th Edition, 2016
 - ACI Building Code for Reinforced Concrete Aluminum Association of America
 - ICC300 per NYSBC 1025.1.1
- D. Bidding: Contractor shall bid press box as detailed and specified. If modifications are required by regulatory agencies, changes will be negotiated and incorporated into the contract by Change Order.
- E. For fabrication of the press box, use only personnel who are thoroughly trained and experienced in the fabrication of grandstands and bleachers. Seating shall be designed to meet or exceed specified fire and safety codes. Provide Product Liability Certificate of Insurance coverage for life of product.

- F. List minimum of three (3) similar jobs for the Architect or Owner to review prior to accepting the suppliers bid proposal.
- G. NY State Professional Engineer (PE) employed by the contractor will verify soil bearing capacity of on site soils from provided soil boring, pit information, and additional testing as the PE deems necessary. The PE is solely responsible for design interpretations and subsequent design of the press box and its structural attachment to the existing bleachers.

1.08 SUBSTITUTIONS

- A. If a product is being submitted as a substitution to the specified product; then the Prime Contractor shall submit and request a product material substitution with his/her bid. The Prime Contractor shall at a minimum provide the following for review by the Architect and Owner:
 - 1. All submittals as specified herein
 - 2. Product comparison
 - 3. Cost Information (including proposal of change in Contract Sum)
 - 4. Contractor's certification that proposed substitution complies with requirements in the Contract Documents
 - 5. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

1.09 WARRANTY

- A. Warranty: Press box shall be guaranteed for one (1) year against defective material or workmanship from date of substantial completion.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. E&D Specialty Stands, Inc. North Collins, NY (800) 525-8515; Dant Clayton Corporation, (800) 467-3655; Sturdi-Steel (800) 433-3116 or Architect approved equal. Listing as acceptable manufacturer does not remove responsibility to meet specifications.

2.02 GENERAL/STRUCTURAL

- A. Railings and guards are installed by contractor on site and are subject to inspection of local officials having jurisdiction.

- B. Exterior bracing provided by 1/2" CDX and glued with approved PVA glue at all stud to endwall connections.
- C. Approved data plate and third-party label to be located on main entrance panel on site structure to meet the following:
 - 1. Uplift rating from edge rails to support and resist 2100 lbs. at 6'-0" o.c.
 - 2. Rating of horizontal connection to be minimum of 2300 lbs at 6'-0" o.c.
- D. Attic ventilation shall not be less than 1/150 of the horizontal area to be ventilated.
- E. All locks to be un-lockable from the interior without the use of a key or special knowledge.
- F. Corrosion resistant flashing at top and sides of doors, windows, and at roof penetrations.
- G. All glazing within 24" arc of vertical door edges in the closed position to be safety glazed and marked so.
- F. Size and Type: overall size of press box shall be 10' x 36' (see site drawings). The type of construction shall be wood framed 5A one-hour fire-rated construction.
 - 1. All Structural Steel Channel: ASTM A36 Fy=36ksi
 - 2. All Structural Steel Tubes: ASTM A500 GRB=46ksi
 - 3. Steel Studs: ASTM C955 Fy=33ksi
 - 4. Bolts: ASTMA325

2.03 FLOOR CONSTRUCTION

- A. Bottom Board: One (1) layer 1/2" Hardie Backer Cement Board under one (1) layer 5/16" Hardie Siding painted black.
- B. Insulation: 6" R-19 fiberglass batts, with vapor barrier.
- C. Joists: 2" x 10" #1 SYP, on 16" centers, longitudinal framing.
- D. Sub Floor: 1/2" CDX plywood, APA rated 32/16.
- E. Decking: 3/4" Sturdifloor, underlayment grade, tongue and groove fir plywood, APA rated, 20" O.C.
- F. Covering: 1/8" Armstrong Excelon vinyl composition tile, Cottage Tan or Architect approved equal.
- G. Molding: 4" vinyl base molding by Roppe or Architect approved equal.

2.04 WALL CONSTRUCTION

- A. Studs: (Welded Framing): 2" x 6", #2 or better SPF, on 16" centers, IBC framing.

- B. Bottom Plate: 2" x 6" #2 or better SPF.
- C. Top Plates: (2) 2" x 6" #2 or better SPF.
- D. Headers: As span and design load requires. Minimum (2) 60CSJ16, 6" x 16ga. welded galvanized steel joists.
- E. Ceiling Height: 8'-0" x 7'-10", front to back.
- F. Interior Sheathing: 5/8" type-x fire-rated gypsum, UL fastening, Class A F.S.R., UL Fastening
- G. Covering: 1/2" or 5/8" vinyl faced gypsum finished interior wall panels, Class A F.S.R.
- G. Insulation: Min. R-13 fiberglass batts with vapor barrier.
- H. Sheathing: 1/2" CDX plywood, UL fastening. (Rear wall to have additional 3/4" CDX for sign attachment.) House wrap air infiltration barrier.
- I. House wrap air infiltration barrier
- J. Siding: Metal Sales "PBU-Panel" .026 gauge ribbed steel panels with Kyner 500 finish, color by Owner.

2.05 ROOF CONSTRUCTION

- A. Joists: 2" x 10", #2 SPF, 16" O.C. spacing.
- B. Overhang: 15-1/2" over front wall; 6" over rear wall. .019 aluminum fascia with perforated aluminum soffit panels.
- C. Subceiling: 5/8" type-x fire-rated gypsum board, UL fastening, Class A.F.S.R.
- D. Ceiling: 5/8" type-x fire-rated gypsum board, taped and bedded with spray textured finish, Class A F.S.R.
- E. Insulation: 6" R-30c fiberglass batts with vapor barrier.
- F. Decking: 1/2" CDX plywood, APA rated 32/16 under 5/8" Sturdifloor, underlayment grade, tongue and groove fire plywood, APA rated 20" O.C.
- G. Covering: .060 polyester reinforced skid and spike resistant PVC membrane, fully adhered.

2.05 WINDOWS

- A. Lindsay #3300 "Earthwise Series", double horizontal slider windows w/ extruded vinyl frames, AAMA LC-25 structural rating, w/ 3/4" insulated low-e, argon filled tempered safety glass and removable insert screens (both sashes are removable) or Architect approved equal.

- B. Interior Windows to be 1/4" tempered safety glass fixed pan with stained jambs and casing.

2.06 DOORS

- A. 36" x 80", 18 ga. insulated vinyl faced steel clad with wood jambs; 16" insulated/tempered threshold, hollow metal doors with 16 ga. steel wrap around frames, hydraulic closer, 10" x 10" window, vinyl weather stripping, aluminum stops, stainless steel thresholds, and heavy duty retention chains. Doors equipped with commercial lever-handled keyed locksets to match District standards.
- B. Doors (Interior) - 1-3/8" Solid-core stained birch with stained birch wood jambs and casing and passage lever handled hardware

2.07 ELECTRICAL

- A. Service Entrance Panel: Square D Q0112M100 with Main Disconnect; rated at 120/240v, single phase, 100 amp capacity.
- B. Receptacles: Pass & Seymour 125 volt/15 amp duplex, spec-grade, along the rear wall. Wiremold 5400 Series two-piece multi-channel, dual voltage, non-metallic surface raceway along front wall below scorer's counter, outlets on 48" centers or Architect approved equal.

Provide outlet (exterior grade) to roof deck.
- C. Pull boxes shall be per plans.
- D. Lighting: SATCO #45/LED/1x4/Flush/3K/WH 45 watt, 1'x4' Surface mount light or Architect approved equal.

Exterior: Lithonia #OSC-13F-120-P-LP-WH 13 watt fluorescent light (waterproof) with photo eye.

Emergency/Exit: Lithonia ECR-LED-HO emergency combination exit/flood light with 90 min.battery back-up and ECA-LED-WP remote emergency flood light.
- E. Circuits: All branch circuit wiring is minimum #12 THHN encased in EMT thinwall conduit or MC Cable.
- F. HVAC: TPI radiant electrical forced baseboards heaters with integral themorstats or Architect approved equal.
- G. All components to be UL listed.
- H. Electrical service from school to press box and final connection shall be by Electrical Contractor.
- I. work shall meet 2008 National Electric Code.

2.08 SCORERS' COUNTER

- A. 18" deep x 3/4" lauan grade plywood with 1-1/2" x 2" edge, surfaced with .060 plastic laminate and grommets spaced 6 ft on center for access to wiremold plug strips, Nevamar Neutra Matrix.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Work shall be performed by factory trained technicians, experienced in press box seating installation. Coordinate with Electrical Contractor to provide a fully operational press box with auxiliary features.
- B. Completed installation shall be as shown on plans and on approved shop drawings.

3.02 CLEANING

- A. Clean all surfaces according to manufacturer's recommendations.
- B. Remove all packaging and construction debris.

END OF SECTION

SECTION 32 30 08

INFIELD WORK

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Infield work includes, but is not limited to, the following:
 - 1. Subgrade Preparation
 - 2. Coarse Sand Layer
 - 3. Skinned Infield Mix
 - 4. Clay Field Bricks
 - 5. Home Base Clay Mix
 - 6. Mound Clay Mix
 - 7. Pitcher's Rubber, Home Plate, and Bases
(both natural grass & synthetic turf fields)
- B. Provide materials, labor, equipment and services required to accomplish related work in accordance with the drawings and specifications.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 31 22 01 - Site Earthwork
- B. Section 32 31 01 - Vinyl Clad Chain Link Fence, Backstops and Gates

1.03 REFERENCES

- A. National Federation of State High School Associations (NFHS) Rules and Interpretations, latest edition.
- B. American Sports Builders Association (ASBA) Sports Field, A Construction and Maintenance Manual, latest edition.

1.04 SUBMITTALS: (See Section 31 12 01, 1.05)

- A. Provide material certificates showing content/mechanical analysis, Manufacturer's Product Data (MPD), and samples required as follows:
 - 1. Coarse Sand: Material certificate and six (6 oz.) ounce sample
 - 2. Skinned Infield Mix: MPD, Material Certificate and six (6 oz.) ounce sample
 - 3. Home Base Clay, Mound Clay: MPD, Material certificate and six (6 oz.) ounce sample
 - 4. Field Bricks for Pitcher's Mound, Catcher's Area and Batter's Box
 - 5. Pitcher's Rubber, Home Plate, and Bases

1.5 JOB CONDITIONS

- A. Job conditions in Section 31 22 01 apply.
- B. Notify the Architect when each major component is near completion for review prior to proceeding to next operation.

1.6 QUALITY ASSURANCE

- A. Provide a field representative to coordinate and review the component parts of the infield work.
- B. Proof roll subgrade with small (2-3 ton) residential scale roller to provide a smooth, evenly compacted surface.
- C. Use landscaping edging with stakes as a temporary divider prior to installing lawn and sand/infield mix. Edging provides a neat line to place all materials against.
- D. Install coarse sand and infield mix in carefully measured layers.
- E. Little storm water percolates through the high percentage silt-clay infield mixture. Therefore, surface planarity is critical for proper drainage. Prior to acceptance, provide an as-built survey of the clay infield areas with spot grade elevations 10 feet on center and 0.1 foot contours to verify accuracy.
- F. The finish surface shall have no depressions or ridges exceeding one-eighth (1/8") inch in ten (10') feet. Also, no small ponds or bird baths larger than three (3 s.f.) square feet are acceptable. Make all necessary corrections as directed by the Architect.
- G. The Contractor shall maintain the infield mix free of weeds until final acceptance by the Owner.

PART 2 - PRODUCTS

2.01 COARSE SAND

Shall be clean, coarse concrete sand, graded as follows:

<u>Standard ASTM Sieve Size</u>	<u>Percent Passing By Weight</u>
Passing 3/8"	100
Passing No. 4	75 - 90
Passing No. 16	30 - 45
Passing No. 50	5 - 10
Passing No. 100	2 - 5

2.02 SKINNED INFIELD MIX

- A. Provide a natural surface with the following characteristics:
 - 1. Provides firm traction.
 - 2. Provides good drainage with minimal accumulation of surface water.
 - 3. Provides adequate moisture retention for insurance of pliable surface texture.
 - 4. Provides adequate compaction while retaining ability to be worked up easily during maintenance procedures.
 - 5. Free of stone.
 - 6. Reddish, orange color for aesthetic quality.
 - 7. No separation of ingredients.
- B. Analysis of ingredients shall be as follows:
 - 1. Mechanical Analysis:
 - Sand: 65-75%

Silt: 10-20%
Clay: 10-20%

2. Sand Sieve Analysis:

<u>Screen Size</u>	<u>Percent Passing</u>
3/8" (9.5mm)	100%
#4 (4.76mm)	95-100%
#7 (2.38mm)	65-75%
#20 (0.84mm)	55-65%
#60 (.25mm)	50-60%
#100 (.149mm)	40-50%
#200 (.075mm)	35-45%

3. DENSITY: Approximately 85 lbs. per cubic foot or 2,300 lbs. per cubic yard.

C. Standard of quality shall be Infield Clay 20 Series (Standard) by Mar-Co Clay Products, Inc., www.marcoclay.com or as distributed by Northern Nurseries, Cicero, NY, (315) 699-3999 or Architect approved equal.

2.03 HOME BASE BLEND CLAY MIX

A. Provide a natural surface with the following characteristics:

1. Provides firm traction.
2. Provides good drainage with minimal accumulation of surface water.
3. Provides adequate moisture retention for insurance of pliable surface texture.
4. Provides adequate compaction while retaining ability to be worked up easily during maintenance procedures.
5. Free of stone.
6. Reddish, orange color for aesthetic quality.
7. No separation of ingredients.
8. Compatible with field bricks.

B. Analysis of ingredients shall be as follows:

1. Mechanical Analysis:

Sand: 55-65%
Silt: 18-25%
Clay: 20-25%

2. Sand Sieve Analysis:

<u>Screen Size</u>	<u>Percent Passing</u>
#4 (4.76mm)	100%
#8 (2.38mm)	95-100%
#20 (0.84mm)	65-75%
#60 (.25mm)	60-65%
#100 (.149mm)	50-60%
#200 (.075mm)	40-50%

3. DENSITY: 2,400 lbs. per Cubic Yard.

- C. Standard of quality shall be Home Base Blend by Mar-Co Clay Products, Inc., www.marcoclay.com or as distributed by Northern Nurseries, Cicero, NY, (315) 699-3999 or Architect approved equal.

2.04 MOUND CLAY MIX

- A. Same characteristics as noted in 2.03, A., above.
- B. Analysis of particle size shall be as follows:

- 1. Mechanical Analysis:

Sand: 25-35%
 Silt: 35-45%
 Clay: 35-45%

- 2. Sand Sieve Analysis:

<u>Screen Size</u>	<u>Percent Passing</u>
#4 (4.76mm)	100%
#20 (0.84mm)	80-90%
#60 (0.25mm)	70-80%
#200 (0.075mm)	60-70%

- 3. DENSITY: 2,500 lbs. per Cubic Yard.

- C. Standard of quality shall be Mar-Co Mound Clay as manufactured by Mar-Co Clay Products, Inc., www.marcoclay.com or as distributed by Northern Nurseries, Cicero, NY, (315) 699-3999 or Architect approved equal.

2.05 FIELD BRICKS

- A. Shall be 4" x 8" x 2 ½" compressed clay specifically designed for home plate and pitcher's circle construction.
- B. Standard of quality shall be Marco-Field Bricks as manufactured by Mar-Co Clay Products, Inc., www.marcoclay.com or as distributed by Northern Nurseries, Cicero, NY, (315) 699-3999 or Architect approved equal.
- C. Layout of field bricks shall be as recommended by the distributor.

2.06 PITCHER'S RUBBER, HOME PLATE AND BASES (both natural grass & synthetic turf fields)

- A. Pitcher's Rubber: Shall be re-moveable, 6" x 24" white rubber with double 1-1/2" ground anchor and two (2) plugs. Standard of Quality shall be Deluxe Double Stanchion as manufactured by Beacon Ball Fields or Architect approved equal.
- B. Home Plate: Shall be five sided, high durability, all rubber, 3" thick with nonskid surface. Standard of Quality shall be Hollywood Bury ALL as manufactured by Beacon Ball Fields or Architect approved equal.
- C. Bases: Shall be natural rubber cover over foam core, 15" x 15" x 3", set of 3 bases with 1½" anchors and rubber plugs, including out tool. For the softball fields provide double first base with orange side for runner. Standard of Quality shall be Pro-Style Original

Jack Corbett Model Base Setsand Hollywood Double Impact First Bases as manufactured by Beacon Ball Fields (800) 747-5985 or Architect approved equal.

PART 3 - EXECUTION

3.01 FIELD LAYOUT: Per Section 31 22 01, 1.05, C. and 3.01.

3.02 SUBGRADE PREPARATION

- A. Grade subgrade parallel to the finish grade.
- B. Provide grade stakes 25 feet on center for grade control.

3.03 TEMPORARY EDGING

Provide landscape edging with stakes as a temporary divider prior to installing lawn and sand/infield mix has stabilized. Carefully remove when lawn and sand/infield mix has stabilized.

3.04 PITCHER'S RUBBER, HOME PLATE, AND BASES (both natural grass & synthetic turf fields)

- A. Install pitcher's rubber and bases as recommended by the manufacturer.
- B. Install home plate as recommended by the manufacturer.

3.05 FIELD BRICKS

- A. Install pitcher's circle, catcher's area, and batter's boxes as recommended by the manufacturer and as directed by the Architect.
- B. Install home plate clay field bricks as recommended by the manufacturer and as directed by the Architect.

3.06 COARSE SAND

Place and compact layer of sand on the prepared subgrade. Thickness of layer depends on location. Refer to table below and drawing details. Work lightly to achieve optimum density.

3.07 INSTALL SKINNED INFIELD MIX

- A. Place in 1-1/2" to 2" layers at a time, wetting and compacting each layer. Total depth varies depending on location. Refer to drawings.
- B. Schedule of Skinned Infield Mix as follows:

	Coarse Sand	Skinned Infield Mix	Field Bricks	Home Base Blend	Mound Clay Mix	Total Depth in Inches *
General Infield Area	2"	4"				6"
Home Plate Area with Field Bricks	2 1/2"		2 1/2"	1"		6"
Home Plate Area without Field Bricks	2"			4"		6"

Pitcher's Circle Area with Field Bricks	2 ½"		2 ½"		1"	6"
Pitcher's Circle Area without Field Bricks	2"				4"	6"

*All materials are installed over a minimum depth gravel blanket refer to details.

3.08 INSTALLATION - PITCHER'S MOUND AND CIRCLE

- A. Install field bricks in a tightly laid pattern as detailed. Spread a thin layer of mound clay over the bricks to fill any cracks and tamp firmly.
- B. Spread mound clay inside the pitching mound radius or box in lifts of 2" depth and compact until the required elevations are achieved.
- C. Soak heavily and tarp to cure.
- D. Rake surface loosening top 1" depth after cure period. Re-compact, soak and tarp to cure.

3.09 INSTALLATION - HOME PLATE AREA

- A. Install field bricks in a tightly laid pattern as detailed. Spread a thin layer of home base clay over the bricks to fill any cracks and tamp firmly. Dampen clay to assist bonding to bricks.
- B. Spread home base clay mix to radius in lifts of 2" depth and compact until the required elevations are achieved.
- C. Soak heavily and tarp to cure.
- D. Rake surface loosening top 1" depth after cure period. Re-compact, soak and tarp to cure.

3.10 DRAG SURFACE

- A. Fine grade infield surfaces with rigid baseball diamond drag mats and hand tools until surfaces meet smoothness requirements below.
- B. Surface Smoothness: Provide smooth, even draining surface, meeting the following requirements:
 - 1. At perimeter where skinned infield mix abuts turf, the grades shall be flush and even.
 - 2. Internally, skinned infield mix areas shall be acceptable when surfaces are tested with a ten (10') straight edge or taught string line and surface variations are less than 1/8".

3.11 QUALITY ASSURANCE AND AS BUILT SURVEY

- A. Shall be as described in this specification section, 1.06.

3.12 CLEAN UP

During the contract and at intervals as directed by the Architect and as baseball infield work is completed, clear the site of extraneous materials, rubbish, and debris. Leave the site in a clean, safe, well draining, neat condition.

END OF SECTION

SECTION 32 31 01

VINYL CLAD CHAIN LINK FENCE, BACKSTOPS AND GATES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. The extent of vinyl clad chain link fence is shown on the drawings.
- B. Provide all materials, labor, equipment, and services required to accomplish all related work in accordance with the drawings and specifications.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 31 22 01 - Site Earthwork
- B. Section 32 12 01 - Asphalt Paving
- C. Section 32 13 01 - Site Concrete Work

1.03 REFERENCES

- A. ASTM F552 Standard Terminology Relating to Chain Link Fencing
- B. ASTM F567 Standard Practice for Installation of Chain Link Fence
- C. ASTM F626 Standard Specification for Fence Fittings
- D. ASTM F668 Standard Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain Link Fence Fabric
- E. ASTM F900 Standard Specification for Industrial and Commercial Swing Gates
- F. ASTM F934 Standard Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials
- G. ASTM F1043 Standard Specification for Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework
- H. ASTM F1083 Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
- I. ASTM F1184 Standard Specification for Industrial and Commercial Horizontal Slide Gates.
- J. WLG 2445 Chain Link Fence Manufacturers Institute, Chain Link Fence Wind Load Guide for the Selection of Line Posts and Line Post Spacing.

1.04 SUBMITTALS

- A. Provide Qualification Experience requirements as specified in "Quality Assurance" of this section. Provide a list of completed projects including Owner contact information.
- B. Manufacturer's Product Data (MPD): Manufacturer's catalog cuts indicating material compliance and specified options.

- C. Shop Drawings: For fence, backstops, and gates including plan layout and details illustrating fence heights, location and sizes of posts, finishes, rails, braces, and installation procedures. Provide footing sizes and hardware list.
- D. Samples:
 - 1. 4" section of line post with specified vinyl coating.
 - 2. 12" x 12" section of vinyl fence fabric .
- E. PVC Fence Cap: MPD and color chart for Owner selection.
- F. Provide a copy of manufacturers 15-year warranty.

1.05 JOB CONDITIONS

- A. All job conditions in Section 31 22 01 apply.
- B. Construction Review: Notify the Architect when fence and gates are staked out.

1.06 QUALITY ASSURANCE

- A. Manufacturer: Company having manufacturing facilities in the United States with five (5) years experience specializing in manufacturing of chain link fence products.
- B. Fence Contractor: Contractor having five (5) years experience installing similar projects in accordance with ASTM F567.
- C. Tolerances: ASTM current specification and tolerances apply and supersede any conflicting tolerance.
- D. Single source: To ensure system integrity obtain the chain link system, framework, fabric, fittings, gates and accessories from a single source.

1.07 WARRANTY

- A. Provide manufacturer's standard limited warranty that its chain link fence system is free from defects in material and workmanship including cracking, peeling, blistering and corroding for a period of fifteen (15) years from the date of purchase.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Vinyl Chain Link Fence and Gates: Shall conform to Chain Link Fence Manufacturer's Institute specifications. See drawings for sizes of posts and fabric.
- B. All posts, rails, fittings, fabric and tension bars shall be vinyl coated galvanized steel, painting of these items will not be acceptable.
- C. Color System: All posts, rails, fittings, fabric, hardware, and tension bars shall be black in compliance with ASTM F934.
- D. Standard of quality: shall be Color Bond II, Class 2b as manufactured by Merchant Metals, (888) 260-1600 or Architect approved equal.

2.02 CHAIN LINK FABRIC

- A. The base metal of chain-link fabric is composed of commercial quality medium high carbon, hot-dipped galvanized steel wire. Core wire tensile strength 75,000 psi.
- B. The vinyl coating is securely fused over the galvanized steel wire by the Thermal Fusion process under pressure to 5,000 psi to insure a dense and impervious covering free of voids, having a smooth and lustrous surface appearance. The vinyl coating thickness, 6 mil (0.15 mm) to 10 mil (0.25 mm), zinc coating weight, and wire tensile strength conforms to ASTM F668 Class 2B. The wire shall be vinyl clad before weaving and is free and flexible at all joints. The mesh is measured by the distance between the wires forming parallel sides of the mesh. The height of the fabric, measured from the ends of the knuckles, has a permissible variation of plus or minus one inch.
- C. Wire Coating: Only Plasticized Polyvinyl Chloride (PVC) with low temperature (-20 degrees C.) plasticizer, no fillers, extenders or extraneous matter, other than the necessary stabilizers and pigments are used. Colors are stabilized and have a light fastness that withstands a minimum WEATHER-O-METER exposure of 4,000 hours without any deterioration (Test Equipment Operating Light and Water Exposure Apparatus Carbon-Arc Type) ASTM-D 1499. The vinyl covering, in addition, resists attack from prolonged exposure to diluted solutions of most common mineral acids, sea water and diluted solutions of most salts and alkali.
- D. Fabric is knuckled at both selvages (top and bottom). Any twisted salvage will be rejected.

Usage	Mesh Size	Break Load of Wire	Thermally Fused -Vinyl Coated Core Wire Gauge
Standard	2" (50 mm)	1290 lbF	9 ga. [0.148" (3.76 mm)]
Backstop Reinforcement	2" (50 mm)	2170 lbF	6 ga. [0.192" (4.88 mm)]

2.03 STEEL PIPE FRAME WORK

- A. Steel pipe Type I: ASTM F1043 Group IA, ASTM F1083 standard weight schedule 40 hot-dip galvanized pipe having a zinc coating of 1.8 oz/ft² (550 g/m²) on the outside and 1.8 oz/ft² (550 g/m²) on the inside surface. Exterior of pipe to have ASTM F1043 PVC thermally fused color coating, minimum thickness 10 mils (0.254 mm) to 15 mils (0.38 mm). Regular Grade: Minimum steel yield strength of 30,000 psi (205 MPa) [all sizes]
- B. Top, Intermediate and Bottom Rails: Top rail is thermally fused vinyl coated galvanized steel pipe in 21 foot lengths jointed by 7" inches long sleeves, vinyl clad, to run continuously along top of fence. Bottom and intermediate rails shall conform to specifications for top rail and are jointed at line posts with vinyl clad boulevard clamps.
- C. Line Posts: Line posts are thermally fused vinyl coated galvanized steel pipe. Posts are sufficient length to allow for installation as detailed and are spaced in the line of fence not farther apart than 10 feet.

- D. Terminal and Corner Posts: Shall be thermally fused vinyl coated galvanized steel. Each post is of sufficient length to allow for a depth as detailed. Fabric is attached to the terminal post by means of vinyl coated tension bars and held by vinyl coated tension bands. Corner posts are placed at each change in direction or as directed by the Architect. All corner and terminal posts are braced with vinyl-clad galvanized steel 1.66 inch O.D. brace, rail, 10 feet long, with a diagonal 3/8 inch diameter truss rod, and attached to the first adjacent line post.

2.04 FITTINGS

- A. All fittings to be PVC thermally fused color coated having a minimum thickness of 0.006" (0.152 mm) per ASTM F626. PVC color to match fabric and framework. Moveable parts, nuts and bolts to be field coated with PVC liquid touch up after installation.
- B. Post caps: ASTM F626 galvanized pressed steel, malleable iron, or aluminum alloy weather tight closure cap for tubular posts. Provide one cap for each post. For top rail, provide line post loop tops to secure top rail.
- C. Rail ends: Galvanized pressed steel per ASTM F626, for connection of rails to post using a brace band.
- D. Top rail sleeves: 7" (178 mm) PVC coated galvanized steel sleeve per ASTM F626 that allow for expansion and contraction of rail.
- E. Wire ties: 9 gauge (0.148") (3.76 mm) vinyl coated galvanized steel wire for attachment of fabric to line posts and rails. Tie wire PVC coated and in compliance with ASTM F626. Color to match fabric color.
- F. Brace and tension (stretcher bar) bands: ASTM F626 galvanized 12 gauge (0.105") (2.67mm) pressed vinyl coated steel by 3/4" (19mm) formed to a minimum 300 degree profile curvature for post attachment. Secure bands using minimum 5/16" (7.94 mm) galvanized carriage bolt and nut.
- G. Tension (stretcher) vinyl coated galvanized steel bars: One piece lengths equal to 2 inches (50 mm) less than full height of fabric with a minimum cross-section of 3/16" x 3/4" (4.76 mm x 19 mm) per ASTM F626. Provide tension (stretcher) bars where chain link fabric is secured to the terminal post.
- H. Truss rod assembly: PVC coated galvanized steel minimum 5/16" (7.9mm) diameter truss rod with pressed steel tightener, in accordance with ASTM F626.
- I. Carriage bolts and nuts: Galvanized of commercial quality but not vinyl coated. Provide PVC touchup paint to color coat all nuts and bolts, when fence is completed.

2.05 CHAIN LINK SWING GATES

- A. Swing gates: Fabricate chain link swing gates in accordance with ASTM F900. Gate frame to be of welded construction. Weld areas to be protected with zinc-rich paint per ASTM A780 then over coated with liquid PVC to match frame. The gate frame members are to be spaced no greater than 8' 0" (2.44 m) apart horizontally or vertically. Exterior members to be 1.900" (48.3 mm) OD pipe, interior members when required shall be 1.660" (42.2 mm) OD pipe. PVC coated pipe to be [Grade 1 ASTM F1083] per section 2.3. Chain link fabric to match specification of fence system. Fabric to be stretched tightly and secured to vertical outer frame members using tension bar and tension bands

spaced 12" (304.8 mm) on center and tied to the horizontal and interior members 12" (304.8 mm) on center using 9 gauge vinyl coated galvanized steel ties per section 2.4.

- B. Hinges: Hot dip galvanized powder coated pressed steel or malleable iron, structurally capable of supporting gate leaf and allow opening and closing without binding. Non-lift-off type hinge design shall permit gate to swing 180°.
- C. Latch: Powder coated galvanized forked type capable of retaining gate in closed position and have provision for padlock. Latch shall permit operation from either side of gate.
- D. Double gates: Provide powder coated galvanized drop rod with center gate stop pipe or receiver to secure inactive leaf in the closed position. Provide powder coated galvanized pressed steel locking latch, requiring one padlock for locking both gate leaves, accessible from either side.
- E. Keeper to secure open leaves: Provide galvanized gate hold back keeper for each gate leaf over 5' (1524 mm) wide. Gate keeper shall consist of mechanical device for securing free end of gate when in full open position. Verify with Owner and Architect prior to installing.
- F. Latch, hinges, moveable parts shall be field coated with liquid PVC.
- G. Gate posts: PVC color coated Grade 1 pipe ASTM F108 per section 2.03.

2.06 FENCE GUARD/CAP

- A. Install 1660 linear feet at track fencing.
- B. Shall be premium grade, 3" wide x 4 ½" high, and wall thickness of .10"
- C. Constructed of heavy duty, UV resistant polyethylene. Color selected by Owner.
- D. 5-Year Limited Warranty.
- E. Basis of design and standard of quality shall be Premium Fence Guard as distributed by Springfield Specialties, Inc., 888-975-3343, or Architect approved equal.

2.07 CONCRETE FOOTINGS

- A. Shall be 4,000 psi as specified in Section 32 13 01, 2.01.

PART 3 - EXECUTION

3.01 SITE EXAMINATION AND PREPARATION

- A. Ensure property lines and legal boundaries of work are clearly established.
- B. Survey of fence location to be provided by Site Contractor.
- C. Clearing: The Site Contractor shall clear, grub and remove vegetation/debris for the fence installation area.
- D. Verify areas to receive fencing are completed to final grade with finished elevations shown on the drawings.

3.02 CHAIN LINK FRAMEWORK INSTALLATION

- A. Install chain link fence system in accordance with ASTM F567, manufacturer's instructions, and Chain Link Fence Manufacture's Institute specifications.
- B. Locate terminal post at each fence termination and change in horizontal or vertical direction of 30° or more.
- C. Space line posts uniformly maximum ten (10') feet on center.
- D. Excavation: Drill holes of diameters and spacings shown, for post footings in firm, undisturbed or compacted soil.
 - 1. Excavate hole depths as detailed when in firm, undisturbed soil. Excavate deeper as required for adequate support in soft and loose soils, and for posts with heavy lateral loads.
 - 2. Spread soil from excavations uniformly adjacent to the fence line, or on adjacent areas of the site, as directed.
- E. Setting Posts: Remove all loose and foreign materials from sides and bottoms of holes.
 - 1. Center and align posts in holes. Install posts plumb, in neat, straight lines, and with minimal waviness of top railing.
 - 2. Place concrete around posts in a continuous pour, and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations.
 - 3. Trowel finish tops of footings, and dome surface to direct water away from posts. Extend footings for posts as detailed.
 - 4. Keep exposed concrete surfaces moist for at least 7 days after placement, or cure with curing material, or other acceptable method.
- F. Concrete Strength: Allow concrete to attain at least 75% of its minimum 28-day compressive strength, but in no case sooner than 7 days after placement, before rails, tension bands or fabric is installed. Do not stretch and tension fabric and wires, and do not hang gates until the concrete has attained its full design strength.
- G. Check each post for vertical and top alignment, and maintain in position during placement and finishing operations.
- H. Bracing: Install horizontal brace and truss assembly at mid-height or above for fences 6' (1829 mm) and over at each fabric connection to the terminal post. The diagonal truss rod is installed at the point where the brace rail is attached to the terminal post and diagonally down to the bottom of the adjacent line post. Place the truss rod in tension by adjusting the turnbuckle.
- I. Top rail: Install in lengths of 21' (6.400 m). Connect ends with sleeves forming a rigid connection, allow for expansion and contraction.
- J. Center Rails: Install mid rails between line posts and attach to post using rail end or line rail clamps. A center rail is required for fabric height 8'-0" and over.

- K. Bottom Rails: Install bottom rails between posts and attach to post using rail end or line rail clamps.
- L. Fasteners: Peen ends of bolts or score threads to prevent removal of nuts. Paint all exposed surfaces, nicks or scratches, nuts and bolts, with liquid black PVC touch up paint.

3.03 CHAIN LINK FABRIC INSTALLATION

- A. Fabric: Install fabric on security side or play side for athletic facilities as directed by the Architect, pull fabric taut; thread the tension bar through fabric and attach to terminal posts with tension bands spaced maximum of 15" (381 mm) on center and attach so that fabric remains in tension after pulling force is released. Install fabric so that it is above finish grade as detailed.
- B. Secure fabric using wire ties to line posts at 12" on center and to rails and braces 12" on center. Tie wire shall be secured to the fabric by wrapping it two (2), 360 degree turns around the chain link wire pickets. Cut off any excess wire and bend back so as not to protrude so as to avoid injury if a pedestrian may come in contact with the fence.

3.04 CHAIN LINK GATE INSTALLATION

- A. Swing gates: Installation of swing gates and gate posts shall be per ASTM F567. Direction of swing shall be as shown on drawings and/or as directed by the Owner. Gates shall be hung plumb in the closed position with minimal space from grade to bottom of gate leaf. Double gate drop bar receiver shall be set in a minimum concrete footing 12" diameter by 48" deep. Gate leaf holdbacks shall be installed on all double gates and all gate leaves greater than 5' (1524 mm) in width as directed by the Owner, if required.

3.05 ACCESSORIES

- A. Fence Cap: Install as directed by the manufacturer at the 4' ht. track fence and gates.

3.06 CLEAN UP

- A. During the contract and at intervals as directed by the Architect and as chain link fence, backstop and gate installation is completed, clear the site of all extraneous concrete, gravel, fence material or debris. Leave the site in a clean, safe, well draining, neat condition.

END OF SECTION

SECTION 32 92 01

SEEDED AND SODDED LAWNS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. The extent of the lawn work is shown on the drawings. The lawn work limits equal the Contract Limit Line except as noted on the drawings. Non-paved, non-roofed areas within the Contract Limit Line shall receive four (4") or six (6") inches settled depth of topsoil and lawn seed or sod. Existing lawn areas that are not disturbed require no additional work. Lawn types as shown on the drawings are defined as follows:
1. Lawn Type 1: Strip and stockpile 4" topsoil, remove debris, replace 4" topsoil, seed, and mulch.
 2. Lawn Type 2: Strip, stockpile 4" topsoil, remove debris, replace 4" topsoil, seed and straw mat.
 3. Lawn Type 3: Strip and stockpile 4" topsoil, add 2" onsite or offsite topsoil, mechanically screen, blend with compost, replace 6" topsoil, and sod.
 4. Lawn Type 4: Strip and stockpile 4" topsoil, remove debris, replace 4" topsoil, and sod.
- B. Lawn work includes, but is not limited to, the following:
1. Placing and spreading stockpiled topsoil
 2. Importing, placing and spreading topsoil
 3. Providing mechanically screened topsoil for athletic fields
 4. Sod bed preparation and placing
 5. Seed bed preparation
 6. Temporary striping of athletic fields for planarity verification
 7. Seeding and sodding lawns
 8. Mulching and fertilizing
 9. Straw mat stabilization
 10. Maintenance: See watering, mowing, fertilizing, core aerating, weed control, grow in and other specific requirements.
 11. Clean Up
- C. Provide materials, labor, equipment, and services required to accomplish related work in accordance with the drawings and specifications.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 31 12 01 - Site Preparation (Topsoil Stripping)
- B. Section 31 22 01 - Site Earthwork
- C. Section 32 30 08 - Infield Work

1.03 REFERENCES

- A. ASTM D4972 - Standard Test Method for pH of Soils
- B. ASTM D5268 - Standard Specification for Topsoil Used for Landscaping Purposes
- C. ASTM D422 and D1140 - Standard Test Method for Particle Size Analysis of Soils

- D. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effect
- E. ASTM F1647 - Standard Test Method for Organic Material Content of Athletic Field Rootzone Mixes.
- F. ASTM F1632 - Standard Test Method for Particle Size Analysis and Sand Shape Grading of Golf Course Putting Green and Sportsfield Rootzone Mixes
- G. ASTM F2060 - Standard Guide for Maintaining Cool Season Turfgrasses on Athletic Fields
- H. National Turfgrass Federation, Inc.
- I. National Turfgrass Evaluation Program (NTEP).
- J. Cornell Universities: Sportsfield Management Guidelines
- K. Turfgrass Producers International: Guideline Specifications to Turfgrass Sodding, latest edition.

1.04 SUBMITTALS: (See Section 31 12 01, 1.05)

- A. Furnish name of Landscape Contractor or Nurseryman to perform lawn work and a list of completed projects including contact information for each project demonstrating compliance with applicable qualification requirements outlined in 1.5 "Quality Assurance" of this specification section.
- B. Provide Material Certificates and MPD for:
 - 1. Sod species and source, location for sod producer
 - 2. Seed species and source
 - 3. Limestone
 - 4. Fertilizers
 - 5. Hydromulch
 - 6. Straw mat - MPD only
 - 7. Straw (dry mulch) - location of straw producer
- C. Provide Topsoil Test Report (for Onsite and Imported Topsoil): Submit test results from Architect approved independent testing laboratory on their letterhead. Report shall:
 - 1. Certify soil texture, organic content, and particle size analysis.
 - 2. Chemical analysis testing nitrogen, phosphorus, potassium, calcium, magnesium, cation exchange capacity, base saturation percentages, micronutrients and acidity (pH).
 - 3. Provide timing and rates of soil additives, liming and fertilizers. (Materials and procedures regarding soil amendments and fertilizers specified in this section are approximate.) Adjust all soil amendments to comply with test results based on actual soil tests and as directed by the Architect at no additional cost to the Owner.
- D. Provide letter on Contractor's letterhead certifying that only topsoil from the above tested source was used on the project.

- E. Lawn Seed Mix: Submit one (1 lb.) pound seed sample for each mix specified in supplier's unopened package with supplier's certification statement clearly showing the following:
1. Name and address of labeler
 2. Lot number
 3. Kind and variety of turfgrass seed listed in order of predominance
 4. Percent by weight of pure seed of each species and variety (percent purity)
 5. Germination percentage (percent viable seed)
 6. Percent by weight of other crop seed
 7. Percent by weight of weed seed
 8. Percent undesirable grass seed
 9. Percent by weight of inert matter
 10. Date on which the germination test was conducted
- F. Submit seed tags from **ALL** used or partially used seed bags. At times throughout the project, the Architect may request seed samples of onsite seed bags.
- G. Provide schedule for review and approval as outlined under "Sequence and Scheduling" of this specification section.

1.05 QUALITY ASSURANCE

- A. General and Athletic Field Lawn Contractor: Work shall be contracted to a single, established Landscape Contracting or Nursery firm having sufficiently experienced crews, supervisor(s), specialized equipment, and an excellent record of performance on completed lawn and athletic field projects of comparable size, scope, and quality. Provide expert turfman to direct the work in the field on a regular, daily basis. The expert turfman shall be employed by the same company engaged in the installation of the lawn and athletic field work for a minimum of five (5) years.
- B. Sod Standards: Comply with the Turfgrass Producers International: Guideline Specifications to Turfgrass Sodding, latest edition.
- C. Nomenclature: Seed names shall conform to the National Turfgrass Federation, Inc.
- D. Seed Quality Rating: Shall meet testing standard for New York State outlined by the National Turfgrass Evaluation Program (NTEP).
- E. Testing: If required by the Architect for poor lawn grow in, engage an Architect approved independent, qualified New York State testing service and turfgrass specialist to evaluate Contractor grow in practices and materials used. Pay for all testing/inspection services, materials, and manpower to correct lawn areas as approved by the Architect.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Sod:
1. Cut, deliver, and install sod within a 24-hour period. Sod cutting and shipping shall be coordinated with the sod installers.
 2. Do not harvest or transport sod when moisture content may adversely affect sod survival.
 3. Protect sod from sun, wind, and dehydration prior to installation.

4. Do not tear, stretch or drop sod during handling and installation.
5. Store sod materials at site in an orderly manner at location(s) acceptable to the Architect.

B. Seed:

1. Packing and Shipping: Ship seed and associated materials with certificates of inspections required by governing authorities.
2. Do not make substitutions. If specified seed material is not obtainable, submit to the Architect proof of non-availability and a proposal for use of equivalent material with similar performance criteria as the originally specified seed material.
3. Store all seed at the site in a cool, dry place in a manner to prevent wetting and deterioration, as approved by the Architect. Replace any seed damaged during storage as directed by the Architect.
4. Deliver seed in supplier's unopened packages bearing labels showing the supplier's name and seed analysis by weight.

C. Fertilizer:

1. Deliver fertilizer in the manufacturer's standard sized bags showing the weight, analysis, and manufacturer's name. Store all fertilizer under a waterproof cover or in a dry place as approved by the Architect.

1.07 JOB CONDITIONS

A. Job conditions in Section 31 22 01 apply.

B. Lawn Work:

1. Perform lawn work after planting, fine grading and other work affecting the ground surfaces in the lawn work areas has been completed satisfactorily.
2. Where practical, the Owner will provide a connection to the water system such as, but not limited to, existing yard hydrants, building hose bibs, etc. If this source is insufficient, not available or practical to provide a source of sufficient water to meet the requirements herein, the Contractor shall secure a water source sufficient to meet the water requirements herein such as, but not limited to, municipal hydrants, water truck, etc. at no additional cost to the Owner.
3. Contractor shall provide all watering equipment and appurtenances such as, but not limited to, meters, backflow preventer, labor, hoses, sprinklers, irrigation and watering equipment. The Owner will pay for the water usage.
4. Calendar dates for seeding and sodding under "Sequence and Scheduling" of this specification section shall apply.
5. Place sod only when ground surface is free of mud, frost, snow and ice.
6. For General Lawn Type 1, perform lawn seeding using mechanical and hand seeding methods. Hydromulching is not permitted within ten (10') feet of buildings edges.

7. For Athletic Field Lawn Type 3, perform seeding using mechanical seeding methods only such as a Brillion or "drill type" seeder as approved by the Architect. Hydroseeding is not acceptable.
 8. Protect newly seeded/sodded lawns from vehicles, vandalism, or trespass. Provide temporary fencing or barriers as required.
- C. Construction Review:
1. Upon completion of topsoil spreading and sod and/or seed bed preparation, notify Architect to review work.
 2. The Architect may review fine graded areas by the Contractor to check for surface smoothness and general compliance with grading requirements. Fill or cut by hand raking or other acceptable means to achieve smooth, even well-draining lawn surfaces free of "bird baths" and breaks in grade as directed by the Architect at no additional expense to the Owner.
 3. On athletic fields the Architect shall review planarity of the field by string grading and/or by visual inspection of the temporary line markings installed by the Contractor prior to seeding/sodding as indicated in Part 3 - Execution.
 4. Review of any fine graded lawn and athletic field areas by Architect shall not alleviate the Contractor of his responsibility for conforming to the required grades as shown on the drawings, nor be misconstrued as final acceptance of lawn work.

1.08 SEQUENCING AND SCHEDULING

- A. Schedule: Prior to construction, provide a schedule which addresses the following lawn thresholds involving erosion control stabilization and competitive use of playfields:
1. Seeding and Sodding Installation: The Contractor may invoice for 50% of the approved schedule of value breakdown at the time of acceptable installation.
 - a. Unless otherwise directed in writing by the Architect, seed and sod lawns from April 1 to May 15, and from August 15 to October 1. Seeding and sodding between May 16 and August 14 is not acceptable unless adequate water supply is available and applied to the turfgrass as required herein and approved by the Architect.
 - b. Proceed with and complete seeding and sodding as rapidly as portions of the site become available, working within the seasonal limitations for each kind of landscape work required.
 2. Substantial Completion: The Contractor may invoice for 25% of the approved schedule of value breakdown at the time of substantial completion as described in Part 3, "Standards For Substantial Completion Of Lawns" of this specification section. At this time, the Architect may issue the Notice of Termination to satisfy the NYS DEC stabilization requirements. The date of substantial completion is anticipated approximately 60 days after lawn installation presuming all Contractor maintenance operations have been vigorously performed.
 3. Final Acceptance: The Contractor may invoice for the final 25% of the approved schedule of value breakdown at the time of final acceptance as described in Part 3, "Standards For Final Acceptance Of Lawns" of this specification section. The date of final acceptance is anticipated approximately 30 days after substantial

completion presuming all Contractor maintenance operations have been vigorously performed.

4. Owner Maintenance: After final acceptance of the lawns, the Owner will maintain for 1 to 3 growing seasons to reach competitive maturity and beyond per ASTM F2060.

PART 2 - PRODUCTS

2.01 TOPSOIL

- A. Source: Provide from off site, Architect approved source, when stripped, stockpiled and amended quantity is inadequate to provide four (4") or six (6") inches settled depth of topsoil for all lawn areas at no additional cost to the Owner.
- B. Texture and Content: Provide topsoil conforming to the following:
 1. Soil texture and content:
 - a. Sandy loam topsoil, well drained homogeneous texture and of uniform grade, without the admixture of subsoil material. Topsoil shall be entirely free of dense material, hardpan, clay, stones over 3/4" in diameter, sod, or any other objectionable foreign material, including but not limited to, glass, debris, toxins, hazardous wastes and chemicals (such as atrizene or muriatic acid within the past seven (7) years) that may be injurious to humans, animals and plant materials.
 - b. Organic Matter: Containing not less than 5% or more than 10% organic matter in that portion of a sample passing a 1/4" sieve when determined by the wet combustion method on a sample dried at 105 degrees F.
 2. pH Value: Containing a pH value within the range of 6.0 to 7.0 on that portion of the sample which passes a 1/4" sieve.
 3. Soluble salt content: Not higher than 500 parts per million.
 4. Sieve Analysis for general lawn work: Shall be screened or rock picked to meet the following gradation:

<u>Sieve Designation</u>	<u>% Passing</u>
3/4"	100
1/4"	97-100
No. 200	20-65 (of the 1/4" sieve)
 5. Sieve Analysis for Athletic Field lawn work: Shall be mechanically screened by an onsite screening facility provided by the Contractor prior to placing and spreading. Athletic field topsoil shall meet the above sieve requirements.
- C. No lawn shall be seeded or sodded on topsoil that has been chemically treated until sufficient time has elapsed to permit dissipation of all toxic materials. The Contractor shall assume full responsibility for any loss or damage to turfgrass sod or the inability to grow a sufficient stand of grass from seed, as indicated herein, arising from improper use of chemicals or due to failure to allow sufficient time to permit dissipation of toxic residues, whether or not such materials are specified herein.

2.02 LAWN SEED MIX

- A. Provide fresh, clean, new-crop seed mixed in the proportions specified for species and variety, and conforming to Federal, State, latest American Association of Nurseryman (AAN) Standards and National Turf Evaluation Program (NTEP).
- B. Acceptable material in a seed mixture other than pure live seed consists of nonviable seed, chaff, hulls, live seed of crop plants and inert matter. The percentage of weed seed shall not exceed 0.05% by weight.
- C. All seed must be fresh seed. Seed that is left over from the previous year and beyond sell by date is not acceptable.
- D. Grass seed shall be certified "Blue Tag" seed composed of a blend of varieties mixed in proportion by weight and tested for minimum percentages of purity and germination. Submit the proposed mixture to the Architect for approval.
- E. Provide the following lawn seed mix:

1. General Lawn Type 1:

<u>Amount by Weight</u>	<u>Species or Variety</u>	<u>Purity</u>	<u>Percentage Germination</u>
40% (Min.)	Kentucky Bluegrass Blend*	95%	85%
35% (Max.)	Fine Textured Endophytic Perennial Rye**	98%	90%
25% (Min.)	Creeping Red Fescue***	97%	85%
100%			

- * Kentucky Bluegrass Blend shall contain no more than 25% of any one cultivar and always at least two (2) different cultivars. Acceptable cultivars: Rambo, Princeton-105, Wildwood, Allure, Coventry, Champagne, Northstar, Cardiff, Nimbus, Raven, SR2100, Misty, America, Brilliant, Limousine, Conni, Liberator, Apollo, NuGlade, Total, Eclipse, Unique, Impact, Midnight, Arcadia, and Serene or Architect approved equal.
- ** Perennial Rye Blend shall contain no more 30% of any one (1) cultivar and always at least three (3) different cultivars. Acceptable cultivars: Palmer III, Calypso II, Brightstar II, Secretariat, Monterey, Catalina, Pennant II, Premier II, Sonata, Sunshine and Ascend or Architect approved equal.
- *** SR5000 is acceptable.

2. Athletic Fields Type 3:

<u>Amount by Weight</u>	<u>Species or Variety</u>	<u>Purity</u>	<u>Percentage Germination</u>
80% (Min.)	Kentucky Bluegrass Blend*	95%	80%
20% (Max.)	Perennial Rye Blend**	98%	90%
100%			

- * Kentucky Bluegrass Blend shall contain a minimum of three (3) of the following varieties in which no less than 60% of the seed shall be at least two (2) of the following cultivars: Rambo, Princeton-105, Wildwood, Allure, Coventry, Champagne, Northstar, Cardiff, Nimbus, Raven, SR2100, Misty, America, Brilliant, Limousine, Conni, Liberator, Apollo, NuGlade, Total Eclipse, Unique, Impact, Midnight, Arcadia, and Serene.

** Perennial Rye Blend shall contain one (1) or more of the following varieties in equal proportions: Palmer IV, Palmer III, Calypso II, Brighstar II, Secretariat, Monterey, Catalina, Pennant II, Premier II, Sonata, Sunshine, and Ascend.

3. Overseeding: Seed blend shall consist of 100% Perennial Ryegrass with at least three (3) cultivars. Acceptable Perennial Ryegrass cultivars include the following: Palmer III, Calypso II, Brighstar II, Secretariat, Monterey, Catalina, Pennant II, Premier II, Sonata, Sunshine, and Ascend. The Perennial Ryegrass shall have a minimum germination percentage of 90%. The percentage of weed seed shall not exceed 0.05% and other crop seed shall not exceed 0.5% by weight of the mixture.

F. Acceptable Seed Suppliers:

United Agri Products
Steve Hyde (315) 383-5035;

Matrix Turf Solutions
Jerry Clark (315) 480-7340;

Lesco, Inc.
Will Abel (315) 437-3423;

Preferred Seed
Jack Bryant (716) 895-7333;

Or Architect approved equal.

2.03 SOD

A. Sod shall conform to NYSDOT Item 713-14 and be approved nursery grown mineral soil sod with 60% Kentucky Bluegrass and 40% Fine Fescue blend with a minimum (4) varieties. Muck grown sod is NOT acceptable. Installation of plastic netting is NOT acceptable.

B. Provide well-rooted, healthy sod, free of diseases, nematodes and soil borne insects. Provide sod uniform in color, leaf texture, density, and free of weeds, undesirable grasses, stones, roots, thatch and extraneous material viable and capable of growth and development when planted. Sod is considered free of weeds when less than five (5) weeds are found per one hundred (100 s.f.) square feet.

C. Thickness of Cut: Furnish sod machine cut at a uniform soil thickness of 0.60 inch at the time of cutting and of supplier's standard width, length, and thickness: uniformly 1" to 1-1/2" thick with clean cut edges. Measurement of thickness shall exclude top growth and thatch. Mow sod before stripping.

D. Mowing Height: Before stripping, sod shall be mowed uniformly at a height of 1 to 1-1/2 inches.

E. Thatch: Sod shall be relatively free of thatch, up to 1/2 inch allowable (un-compressed).

F. Pad Size:

1. For General Lawn: Individual pieces of sod shall be cut to the supplier's standard width and length. Maximum allowable deviation from standard widths and

lengths shall be plus or minus 1/2 inch on width and plus or minus 5% on length. Broken pads and torn or uneven ends will not be acceptable.

2. For Athletic Fields and Other Such Large Areas: Sod shall be thick-cut "big" rolls of 250 s.f. Maximum allowable deviation from standard width and lengths shall be plus or minus 1/8" on width and plus or minus 1/2% on length. Broken and torn or uneven rolls will not be acceptable.

G. Strength of Sod Sections: Standard size sections of sod shall be strong enough to support their own weight and retain their size and shape when suspended vertically from a firm grasp on the upper 10% of the section.

H. Standard of Quality: Shall be Premium Sod supplied by Batavia Turf (800) 333-1472, Sky High Turf Farms (315) 687-6510, Saratoga Sod Farm (518) 664-5038, Lakeside Sod (716) 741-2877 or Architect approved equal.

2.04 LIMESTONE

A. Shall be ground limestone in the producer's standard bags containing not less than 85% total carbonates and conforming to the following gradations:

<u>Sieve Designation</u>	<u>% Passing</u>
No. 100	50-100
No. 20	100

B. The lime shall be uniform in composition, dry and free flowing and shall be delivered to the site in the original, unopened containers, each bearing the manufacturer's guaranteed analysis. Any lime which becomes caked or otherwise damaged making it unsuitable for use will be rejected.

2.05 TACKIFIER FOR SEEDED LAWNS

A. Shall be liquid concentrate diluted with drinkable water forming a transparent three-dimensional film-like crust permeable to water and air, containing no agents toxic to seed germination to hold straw mulch in place.

B. Standard of quality shall be Terra Tack or Architect approved equal.

2.06 FERTILIZER

A. For Starter Fertilization: Immediately prior to seeding, fertilize with a commercial starter fertilizer, granular, non-burning product, with not less than 90% organic slow acting, micro nutrients and 1% iron, guaranteed analysis commercial fertilizer. Fertilizer ratio shall be: (1-2-1). Apply at a rate of 0.33 - 0.66 lbs of nitrogen (N) per 1,000 sf.

B. For Subsequent and Final Fertilizations: Apply commercial fertilizer, poly coated granular non-burning product with not less than 90% organic slow acting, guaranteed analysis

1. For Spring and Fall Lawn Work: Fertilizer ratio shall be: (3-0-1). Apply at rate of 1.5 - 2 lbs nitrogen (N)/1,000 s.f.

2.07 STRAW MAT FOR SEEDED LAWNS

See Specification Section 31 25 01.

2.08 MULCH FOR SEEDED LAWNS

- A. Dry Application Straw: Shall be straw consisting of clean stalks of oats, wheat, rye or other approved crops well seasoned before baling which are free of noxious weed seeds and roots. Weight shall be based on 15% moisture.
- B. Hydro Applications: Shall be hydromulch containing 100% wood fiber mulch. Standard of quality shall be Mat Fiber as manufactured by Mat, Inc. and distributed by Matrix Turf Solutions, (315) 468-6000 or Architect approved equal.

2.09 WATER: Free of substance harmful to lawn, other plants, humans and animals.

2.10 COMPOST

- A. Compost shall contain organic matter or material of a generally humus nature capable of sustaining vegetation growth, with no foreign matter (ie. glass, plastic, etc.) or other material toxic to plant growth. It shall be free from stones, lumps, or similar objects larger than one-half inch in greatest diameter, roots, and brush. Composts derived from organic wastes such as food and agricultural residues and animals manures, and sewage sludge that meet the above requirements, and are approved by the National Environmental Protection Agency and NYS Department of Environmental Conservation are acceptable compost sources.
- B. Compost shall have the following properties:

<u>Parameters</u>	<u>Range</u>
pH	6.0 to 7.5
Moisture Content	35 to 55%
Particle Size	< 1/2"
C:N Ratio	15:1 to 30:1
Soluble Silts	< 4.0 minutes (ds)
Organic Matter Content	> 20%
Bulk Density	< 1200 lbs/cy
Foreign Matter	< 1% (dry weight)

C.	Field Specific Requirements	Min. Compost Needed
	Softball Field	125 Cy
	Track Field	125 cy

- D. Standard of quality shall be WeCare Organics, (845) 753-2242, or Architect approved equal.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Verify limits of lawn and other types of ground cover materials in the field with drawings. Also any imported and screened topsoil areas. Notify Architect of discrepancies prior to proceeding with lawn work.
- B. Examine finish surfaces, grade, topsoil quality, and depth.

- C. Do not start lawn work until unsatisfactory conditions are corrected to the satisfaction of the Architect.

3.02 SPREAD TOPSOIL

- A. Limit preparation to areas which will be immediately seeded or sodded.
- B. Perform topsoil spreading operations only during dry weather.
- C. To insure a proper bond with the topsoil, disc, harrow, or otherwise scarify and loosen the lawn subgrade to a depth of four (4") inches before spreading topsoil.
- D. Spread topsoil to ensure a minimum settled depth of four (4") or six (6") inches in lawn areas.

3.03 PREPARE GENERAL LAWN AREAS TYPE 1

- A. Perform a pH test, sieve, and nutrient analysis of the topsoil and advise the results to the Architect prior to adding limestone or other soil amendments. Soil amendments shall be uniformly incorporated into the top four (4") or six (6") inches of topsoil by discing, harrowing or other approved methods.
- B. Remove debris and stones 3/4" or larger by handpicking, fine tooth aluminum grading rakes, and mechanized stone picker. When topsoil has hardened, cultivate soil to a four (4") or six (6") inch depth by plowing, discing, harrowing, or otherwise scarifying and loosening the topsoil.
- C. Grade lawn areas to a smooth, free draining even surface with a loose, moderately coarse texture. Scarify, rake, level, and roll with a light static roller as necessary to obtain true, even lawn surfaces and fill depressions as required to drain. Correct irregularities in the surface resulting from tillage operations to prevent formation of depressions or water pockets.
- D. Cultivate soil to provide a firm bed of minimum of four (4") or six (6") inches deep, free of clods, stones, or foreign matter over 3/4" in diameter from the top of soil. Do not move heavy objects except necessary lawn making equipment over the lawn areas after the soil is prepared unless it is again loosened and graded. Remove stones and all debris greater than one 3/4" in diameter during cultivation. Level undulations and irregularities in the surface.
- E. For pH correction provide adjusted rate of application as recommended in Topsoil Test Report submittal. For low pH correction: Add ground limestone at the rate indicated by the soil test. For high pH correction: Materials and application rates shall be determined by appropriate soil tests.
- F. Place starter fertilizer at the rate of 0.33 - 0.66 lbs. of nitrogen (N) per 1,000 sf. and mix into full depth of topsoil.
- G. Rake area with fine toothed aluminum grading rake before placing seed to obtain a smooth surface at the proper elevation. Drag area with a wood float to level out minor humps and hollows. Beds shall have a smooth friable uniform surface, free of areas ponding water.

3.04 MODIFY, SCREEN AND SPREAD TOPSOIL IN ATHLETIC FIELD LAWN TYPE 3

- A. Mechanically screen modified topsoil to remove objects greater than 3/4" prior to spreading.
- B. Premix by volume the compost required under Part 2 - Products, of this specification section, to six (6") inches stockpiled or imported topsoil (total 6" settled depth). Perform a pH test of the premixed material and advise the results to the Architect prior to placing limestone or other soil amendments as recommended by the soil test(s).
- C. Perform modified topsoil spreading only during dry weather. Spread to ensure a minimum settled depth of six (6") inches.
- D. Grade lawn areas to smooth, free draining even surface with a loose, moderately coarse texture. Scarify, rake, level, and roll with a light static roller as necessary to obtain true, even lawn surfaces and fill depressions as required to drain. Correct irregularities in the surface resulting from tillage operations to prevent formation of depressions or water pockets.
- E. For pH correction provide adjusted rate of application as recommended in Topsoil Test Report submittal. For low pH correction: Add ground limestone at the rate indicated by the soil test. For high pH correction: Materials and application rates shall be determined by appropriate soil tests.
- F. Place starter fertilizer at the rate of 0.33 - 0.66 lbs. of nitrogen (N) per 1,000 sf. and mix into full depth of topsoil.
- G. Rake area with fine toothed aluminum grading rake before placing seed or sod on athletic fields to obtain a smooth surface at the proper elevation. Drag area with a wood float to level out minor humps and hollows. Beds shall have a smooth friable uniform surface, free of areas ponding water.
- H. Prior to seeding or sodding, place temporary striping lines on the athletic fields with a marking mixture which is not toxic to seed germination. Place straight lines across fields 15' on center. These lines will be reviewed to determine visual planarity of the topsoil surface. Correct high and low spots as directed by the Architect. Drag and spread lines prior to seeding or sodding.

3.05 LAWN SEEDING

- A. Notify Architect when seed bed is ready for review as specified in Job Conditions. Obtain Architect's approval of finish grade prior to seeding.
- B. Seed lawns immediately after preparation of bed and Architect's approval.
- C. For General Lawn Type 1:
 - 1. Seed at the rate of 6 lbs. per 1,000 S.F.
 - 2. Seeding shall be performed as follows: 1/2 rate and mechanically incorporated into the top 1/2" of topsoil. The remaining 1/2 rate shall be mechanically spread at 90 degrees to the first application and lightly rolled.
- D. For Athletic Field Lawn Type 3:
 - 1. Seed at a rate of 4 lbs per 1,000 S.F.

2. Seed 1/2 of the amount needed in one direction and seed the remaining 1/2 at 90° to the first seeding.
3. Seed shall be mechanically applied by use of a drill type seeder. Hydroseeding is NOT allowed for athletic field lawns.

3.06 MULCHING SEEDED AREAS

- A. Mulch immediately after seeding.
- B. Dry Mulch Application: Place mulch by hand or by machine at a rate of one bale/1,000 s.f. to produce a light even mulch cover so that 50% of soil is visible through the mulch layer.
- C. Hydro Application: Place hydromulch by machine at a rate of one bale/1,000 sq. ft. to produce a light even mulch cover so that 50% of soil is visible through the mulch layer. NOTE: Seeding with a hydroseeder is NOT acceptable.
- D. Anchor mulch by thorough heavy coat of tackifier over entire area and watering.
- E. Protect seed bed from washout, wind erosion, rutting and drying out. Do not use machinery that leaves ruts in the seed bed. It is the Contractor's responsibility to add or remove mulch as needed to encourage optimum seed germination and growth.

3.07 INSTALL STRAW MAT

Install as specified in Section 31 25 01, Part 3.

3.08 SODDING

- A. Notify Architect that sod bed is ready for review as specified in Job Conditions. Obtain Architect's approval prior to sodding.
- B. Moistening the Soil: During periods of higher than optimal temperature for species being specified and after unevenness in the soil surface has been corrected, the soil shall be lightly moistened immediately prior to laying the sod.
- C. Sod immediately after preparation of bed and Architect's approval.
- D. Lay sod to form a solid mass with tightly-fitted joints in strips parallel to contours. Butt ends and sides of sod strips. Do not overlap edges. Stagger strips to offset joints in adjacent courses. Remove excess sod to avoid smothering of adjacent grass. Provide sod pad top flush with finish grade of adjacent curbs, pavements, drainage structures and seeded areas.
- E. Do not lay dormant sod or install sod on soil surfaces that are hot, dry, saturated or frozen.
- F. When sodding slopes, install initial row of sod in a straight line, beginning at bottom of slope. Place subsequent rows parallel to and lightly against previously installed row.
- G. Sod strips laid in drainageways must meet the finished grades shown on the drawings.
- H. Sod abutting existing lawn or seeded lawns shall meet flush with top of sod pad (soil and thatch). Remove excess topsoil as necessary to meet flush.

- I. Stake sod in lawn swales and on lawn slopes 3H to 1V (horizontal to vertical) and steeper to prevent slippage. Use two (2) biodegradable stakes per square yard of sod. Stakes are to have their flat sides against the slope and be driven flush with sod surface.
- J. Roll with light static lawn roller to ensure contact with subgrade.
- K. As sodding is completed in anyone section, water sod thoroughly to a depth sufficient to ensure the underside of the new sod pad and topsoil immediately below the pad is thoroughly wet. Contractor is responsible to ensure there is an adequate water supply available prior to installation. Do not allow sod to dry out.

3.09 MAINTENANCE

- A. Maintenance by Contractor begins as soon as lawns are sodded or seeded. Protect lawns from drought, washout and wind erosion. In general, maintain new installed lawn areas, including watering, fertilizing, core aerating, spot weeding, overseeding, mowing, applications of herbicides, fungicides, insecticides, and re-sodding until a full, uniform, healthy, vigorous stand of grass free of weed, undesirable grass species, disease, and insects is achieved and accepted by the Architect. Specifically:
 - 1. Watering Seeded Lawns:
 - a. First Week: In the absence of adequate rainfall, watering shall be performed daily or as often as necessary during the first week to maintain moist soil to promptly germinate the lawn seed, preventing it from drying out, and keeping it in a healthy, growing condition until final acceptance. Lawn areas shall receive a minimum of one (1") of water per week, by natural rainfall, irrigation or a combination of both. Water daily until 2nd mowing (just enough water to keep the top ½" of soil moist, 1 time daily).
 - 2. Watering Sodded Lawns:
 - a. First Week: Soil on sod pads shall be kept moist. In the absence of adequate rainfall, watering shall be performed daily or as often as necessary during the first week and in sufficient quantities to maintain moist soil to a depth of at least four (4") inches.
 - 3. Second and Subsequent Weeks: Contractor shall provide water to the lawns as required to maintain adequate moisture, in the upper four (4") inches of soil, necessary for the promotion of deep root growth until final acceptance. After 2nd mowing, water two (2) times weekly until thoroughly established.
 - 4. Protect: Protect lawn areas against trespass, vandalism and routine pedestrian traffic and Owner maintenance traffic by temporary fencing or other means.
 - 5. Repair: Repair, rework, resod and overseed (as originally specified for that area) areas that have washed out, eroded, do not germinate and are vandalized or otherwise damaged. Overseeding rates are to be adjusted to 6 lbs. of seed per 1,000 s.f.
 - 6. Mow: Initial mowing shall begin when the blade height reaches 2" and the soil will bear the weight of the lawn mower. Use mowers with low impact tires. For the first 3 mowings cut the grass blades to 1.5 inches. After that mow the grass when it reaches a height of about 3.5" to a height of about 2.5". Never remove more than 1/3 of the grass blade at any one mowing. A minimum of eight (8) to

ten (10) mowings are required (approximately once per week after the initial germination period to final acceptance). Notify the Architect of dates in writing as mowing is performed. Excess clippings shall be carefully raked so as not to remove healthy grasses, and removed.

7. Core Aerating: Between mowings three (3) and four (4), and between mowings seven (7) and eight (8) core aerate lawns about three (3") inches on center minimum three (3") inches deep to ensure aggressive root growth. This will require multiple passes at different directions to achieve 16 to 20 holes 3/4" to 1" diameter per square foot. Sweep scattered plugs off paved areas onto adjacent lawn areas. Pulverize plugs during subsequent mowing operations. Provide additional core aerating after the 10th mowing as directed by the Architect to expedite the lawn maturation process. Moisten field by thoroughly watering the topsoil profile, several days in advance of coring to facilitate proper penetration of the topsoil.
 8. Fertilizer: Immediately after core aerating, between mowings three (3) and four(4), and between mowing seven (7) and eight (8) apply subsequent fertilizer at the rate of 1.5-2 lbs./1,000 s.f. Provide additional fertilizer after the 10th mowing as directed by the Architect to expedite the lawn maturation process. Apply a final fertilizer just prior to final acceptance at the same application rate.
 9. Weed Control: When infestation of weeds or crabgrass develops, treat infestation by hand weeding or herbicides control appropriate to the area. Furnish and install weed chemical control as recommended by manufacturer. Herbicides controls must be acceptable to the Owner. Obtain and pay for permits. Use as directed by the manufacturer and applicable laws, codes, ordinances and regulatory requirements. Under NO circumstances is it acceptable to seed or overseed over Nutsedge, Crabgrass or other grassy/broadleaf weeds.
- B. Maintenance by the Contractor continues through the certificate of substantial completion to final acceptance by the Architect as described below. Maintenance by Owner begins after final acceptance of the lawn.

3.10 STANDARDS FOR SUBSTANTIAL COMPLETION OF LAWNS: Review to determine substantial completion of lawns will be made by the Architect, upon request. Provide notification at least five (5) working days before requested review date.

- A. Lawn areas will be substantially complete provided requirements, including maintenance, have been complied with. A healthy, vigorous, uniform, partially mature stand of lawn is established free of weeds, undesirable grass species, disease, and insects. With proper watering and maintenance as indicated herein, this should culminate after an approximate 60-72 day period for initial germination with average temperatures above 40°F. Grass roots shall have matured to a minimum of 1½" depth as determined by the Architect when core samples are taken.
- B. Lawn areas shall not have more than 10% dead/bare spots.
- C. Contractor shall provide a written copy of all maintenance activities performed up to this date.
- D. The architect will prepare a written punch list of items which need correction prior to final acceptance.

3.11 STANDARDS FOR FINAL ACCEPTANCE OF LAWNS: Review to determine final acceptance of lawns will be made by the Architect, upon request. Provide notification at least five (5) working days before requested review date.

- A. Lawn areas will be acceptable provided requirements, including maintenance, have been complied with. A healthy, vigorous, uniform, full stand of lawn is established free of weeds, undesirable grass species, disease, and insects. Grass roots shall have matured to a minimum of 2" depth as determined by the Architect when core samples are taken.
- B. Any lawn which contains disease, more than 1% dead/bare spots, or any dead/bare area greater than one (1) square foot shall be rejected and the unacceptable area(s) repaired as originally specified at no additional cost to the Owner.
- C. In the event the Contractor fails to complete the punch list items within a 30 day period with average temperatures of 40°F after the time of Substantial Completion, the Contractor shall be liable to the Owner for any additional costs including those charged by the Architect.
- D. Contractor shall provide a written copy of all maintenance activities performed during the contract up to final acceptance of lawns.

3.12 CLEAN UP

During the contract and at intervals as directed by the Architect and as lawn work is completed, clear the site of extraneous materials, rubbish, and debris. Leave the site in a clean, safe, neat, well-draining condition.

END OF SECTION

SECTION 33 11 01

WATER DISTRIBUTION

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. The extent of the water distribution system is shown on the drawings.
- B. The water distribution work includes, but is not limited to, the following:
 - 1. Trenching and Backfilling
 - 2. Piping and jointing to five feet from exterior building face
 - 3. Connections to existing water system
 - 4. Valves & Valve Boxes
 - 5. Concrete Thrust Blocks
 - 6. Clean Up
- C. Provide materials, labor, equipment and services required to accomplish related work in accordance with the drawings and specifications.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 31 22 01 - Site Earthwork
- B. Section 32 12 01 - Site Concrete Work
- C. Section 33 11 02 - Disinfection of Water System
- D. Section 33 30 01 - Site Sanitary
- E. Section 33 40 01 - Storm Drainage

1.03 REFERENCES (AWWA, latest edition)

- A. AWWA C104/A21.4 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water; American Water Works Association (ANSI/AWWA C104/A21.4).
- B. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; American Water Works Association (ANSI/AWWA C111/A21.11).
- C. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast, for Water; American Water Works Association (ANSI/AWWA C151/A21.51).
- D. AWWA C502 - Dry Barrel Fire Hydrants; American Water Works Association (ANSI/AWWA C502/C502a).
- E. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service; American Water Works Association (ANSI/AWWA C509/C509a).
- F. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances; American Water Works Association (ANSI/AWWA C600).
- G. UL 246 - Hydrants for Fire-Protection Service; Underwriters Laboratories Inc..

1.04 SUBMITTALS: (See Section 31 12 01, 1.05)

- A. Provide Manufacturer's Product Data (MPD) for:
 - 1. Water pipe and joints
 - 2. Valves and Valve Boxes
- B. Provide Material Certificates and samples as noted:
 - 1. Granular Backfill: Material Certificates and sample.
 - 2. 4,000 psi concrete: Material Certificate showing design mixes.
- C. Permits, Notification, Certification, and Test Reports: Provide per 1.05, C, D and 3.05 below.

1.05 JOB CONDITIONS

- A. Job conditions in Section 33 40 01 apply.
- B. Water distribution work shall conform to standards of applicable government authorities having jurisdiction.
- C. Obtain and pay for permits and approvals required by local authorities. Copy permit to Architect.
- D. Notify Municipal Engineer and Fire Marshall/Chief in writing two (2 wks.) weeks prior to start of work. Copy letter to Architect.
- E. Construction Review: Notify the Architect when the work is approximately 25%, 75% and 95% complete.

1.06 QUALITY ASSURANCE

- A. Perform work in accordance with NYS Health Department Standards.
- B. Codes and Standards: ACI 304 "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete", comply with applicable provisions except as otherwise indicated.

1.07 TESTING

- A. Notify Architect and Municipal Engineer a minimum of forty-eight (48 hrs.) hours in advance.
- B. Provide materials and labor to carry out testing in the presence of the Architect and Municipal Engineer. Test water system with an hydrostatic pressure test for two hours in conformance with AWWA Standard C600.
 - 1. Do not exceed the following leakage rates per 1,000 feet of pipe, respectively, for the two-hour test period at 150 psi:

<u>Pipe Diameter</u>	<u>Allowable Leakage</u>
3/4"	0.124 gal.
1"	0.165 gal.
1 1/2"	0.248 gal.
2"	0.331 gal.

2 ½"	0.414 gal.
4"	0.662 gal.
6"	0.993 gal.
8"	1.324 gal.
10"	1.655 gal.
12"	1.986 gal.

2. Valid test pressure shall not vary more than (+/-) 5 psi.
3. Any leakage beyond limits described shall be located and repaired. Retest system to insure adequate performance of pipe.

PART 2 - PRODUCTS

2.01 PIPING, FITTINGS AND BACKFILL

- A. Ductile iron pipe for four (4") inch internal diameter shall be Class 51 and for 6" and larger internal diameter shall be Class 50, conforming to ANSI/AWWA C151/A 21.51. Mechanical joint bells, glands, bolts, gaskets shall have a working pressure of 350 psi and shall be in conformance with ANSI/AWWA C153/A21.53. Pipe and fittings shall be coated inside and out with coal tar varnish in conformance with ANSI/AWWA C153/A21.53.
- B. PVC pipe, pressure class 200 conforming to AWWA C900. Joints shall be twin gasketed, flexible rubber, rated for maximum working pressure of 200 psi, conforming to ASTM F477.
- C. Two inch water (2"W) pipe shall be Type K soft-tempered copper pipe, with flared fittings.
- D. One (1") inch water pipe shall be ASTM B88, Type "K" soft tempered copper pipe with flared fittings.
- E. Backfill shall be as specified in Section 31 12 01, 2.01.
- F. Concrete for thrust blocks shall be 4,000 psi as specified in Section 32 12 01-2.01.

2.02 GATE VALVE AND VALVE BOX

- A. Gate Valves - Open Counter-clockwise (left)
 1. Valves shall be 125 pound flanged gate valves meeting American Water Works Association (AWWA) Standards, iron body, bronze mounted, double disc type with removable brass seats, non-rising manganese bronze stems, and open counter clockwise.
 2. Valves shall be successfully subjected to a hydrostatic pressure test of not less than four (4) times the maximum working pressure.
 3. Standard of quality shall be AWWA gate valves as manufactured by Kennedy or equal approved by the local Water Authority.
 4. Valves shall be compatible with the type of pipe and joint being used without the use of an adaptor.
- B. Valve Box shall be cast iron, yoke type, adjustable for height with cast iron cover marked "Water". Boxes shall be designed for pipe in trench having a 5'-6" cover over pipe.

2.03 ACCESSORIES

- A. Concrete for Thrust Restraints:
1. Portland Cement: ASTM C150, Type 1A.
 2. Aggregates: ASTM C33; coarse aggregate - crushed limestone, maximum one inch (1") size; fine aggregate - clean, sharp, natural sand.
 3. Water: Clean, potable.
 4. Air-Entraining Admixture: ASTM C260, Darex or Architect approved equal.
 5. Ready Mix Concrete: ASTM C94.
 6. Minimum Concrete Strength: Compressive strength shall be greater than 4,000 psi at 28 days; minimum cement content – 6.5 bags/c.y.; 4.0 gals./bag of cement; slump from 1-1/2" to 3"; air entrainment from 5% to 8-1/2%; and flexural strength (ASTM C78) shall be greater than 650 psi at 28 days.
- B. Flexible Couplings: Smith-Blair Couplings. Approved product numbers:
1. 441 Cast straight & transition coupling
 2. 482 Cast end cap coupling
 3. 261 All stainless steel full circle clamp coupling
 4. 264 All stainless steel tapped full circle clamp coupling
 5. 912 Cast iron flanged coupling adapter
- C. Mechanical Joint Retainer Glands: Ductile iron, AWWA/ANSI C110/A21.10 and C111/A21.11. Set screws shall be 5/8" NC thread with torque-set head, or 5/8" square head bolts, with knurled cup-point, made of 4140 steel and hardened to Rockwell "C" scale 4547.

PART 3 - EXECUTION

3.01 CONNECTIONS TO OTHER WATER SYSTEMS

- A. Connections at Buildings:
1. Locate accurately per site and plumbing drawings. Verify inverts, locations and sizes. Notify Architect of any discrepancies immediately prior to installation.
 2. Install the site water system to within five (5') feet of each building exterior. Install temporary plugs, mark above grade, and protect. Coordinate with the Plumbing Contractor.
 3. The Plumbing Contractor shall be responsible for connecting the building water plumbing system to the site water system and coordinating with this Contractor.
 4. Connect existing building service piping to new distribution main using smooth flexible coupling to join dissimilar pipes to provide watertight joint with low friction loss characteristics.
- B. Connections to the existing water supply system:
1. Provide the Municipality with at least two (2) weeks notice prior to conducting work so that field procedures and installations can be reviewed by a representative of the Municipality. Copy letter to Architect.

2. Locate accurately per site drawings. Verify inverts, locations and sizes. Notify Architect of any discrepancies prior to installation.
3. Connect new ductile iron service main to the existing cast iron main using a Tapping Sleeve and Valve as specified hereafter:
 - a. Pipe to be tapped shall be excavated and thoroughly cleaned at the location to be tapped. Cleaning shall extend a minimum of 12 inches on each side of the sleeve.
 - b. Pipe, sleeve and valve shall be disinfected in accordance with AWWA C651.
 - c. Tapping sleeve and valve shall be installed in accordance with manufacturer's instructions, and bolts tightened to the proper torque.
 - d. Tap shall be made in the presence of Municipal Public Works Plumbing Inspector after sleeve and valve have been pressure tested to ensure proper installation. If sleeve or valve fails pressure test, the defective installation shall be disassembled and reinstalled.
4. Make connections securely, watertight, and as detailed.

3.02 TRENCHING AND BACKFILL

- A. See Section 31 22 01 for additional requirements.
- B. Hand trim excavation for accurate placement of pipe. Remove all stones greater than 4" diameter to a depth of at least 6" below the bottom of the pipe.
- C. Form and place concrete for pipe thrust restraints at each change of pipe direction and dead ends as shown on the Contract Drawings. Place concrete to permit full access to pipe and pipe accessories. Care shall be exercised in the placement of concrete to allow disassembly of mechanical joints.
- D. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

3.03 INSTALLATION - PIPE

- A. Maintain separation of water main from sewer piping in accordance with details shown on Contract Drawings.
- B. Water pipe shall have a minimum of five and one half (5- 1/2') feet of cover as measured from the top of the pipe to finish grades. Bed pipe as detailed. Place backfill around pipes to equal depths on both sides as work progresses. When pipe laying is not actually in progress, the open ends of the pipes shall be closed temporarily with pipe plugs or by other means. When water is in the trench, plugs shall not be removed until danger of water entering the pipe has passed.
- C. Install pipe to indicated elevation to within tolerance of 1 inches.
- D. No pipe shall be laid upon a foundation in which frost exists, nor at any time when there is a danger of the formation of ice, or the penetration of frost at the bottom of the excavation.
- E. Two brass wedges shall be inserted securely between bell and spigot ends of pipes, maintaining the full watertightness of the joint.

- F. Otherwise install ductile iron piping and fittings to AWWA C600.
- G. Route pipe in straight line.
- H. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- I. Install access fittings to permit disinfection of water system performed under Section 33 11 02.
- J. Compact trenches to at least ninety five (95%) percent maximum density as specified in Section 31 22 01. Settlement shall be repaired by the Contractor at no additional cost to the Owner.
- K. Install concrete cradles, saddles and thrust blocks where shown on drawings as detailed and specified in Section 32 13 01, Part 3. Provide bracing and blocking at bends, 22-1/2 degrees or greater, tees, crosses and plugs. Block and anchor with concrete so that there will be no movement of the pipe in the joints due to internal or external pressures. The concrete shall be placed around the fittings and completely fill the space between the fittings and walls of the trench, from 6" below the fittings of pipe, to 12" above the fittings. The anchor concrete shall be so placed that the bell and spigot joints or other joints may be recaulked or tightened if necessary. Concrete thrust blocks shall conform dimensionally to details shown on drawings.

3.04 INSTALLATION - VALVES

- A. Set valves on solid bearing.
- B. Center and plumb valve box over valve. Set box cover approximately one inch below surrounding finished grade. Care shall be exercised in backfilling around valve boxes to prevent displacement of box.

3.05 FIELD QUALITY CONTROL

- A. All new water piping and fittings shall be thoroughly flushed prior to pressure testing. The flushing rate shall be at least 2.5 ft./sec.
- B. Pressure test all new water piping and fittings using a test pressure not less than 150 psi.
- C. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to the Owner.
- D. After all work has been successfully inspected and tested, the new water piping and fittings shall be disinfected by the Contractor in accordance with AWWA C651, latest edition as specified in Section 331102 of these Specifications.

3.06 CLEAN UP

During the contract and at intervals as directed by the Architect and as the water distribution system is completed, clear the site of pipe, trench and backfill material, stone, concrete and debris. Leave the site in a clean, safe, well draining, and neat condition.

END OF SECTION

SECTION 33 11 02

DISINFECTION OF WATER SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Disinfection of site domestic and fire water lines and appurtenances specified in Section 33 11 01.
- B. Testing and reporting results.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 33 11 01 - Water Distribution

1.03 REFERENCES

- A. AWWA B300 - Hypochlorites; American Water Works Association; 1992 (ANSI/AWWA B300).
- B. AWWA B301 - Liquid Chlorine; American Water Works Association; 1992 (ANSI/AWWA B301).
- C. AWWA B302 - Ammonium Sulfate; American Water Works Association; 1995 (Revised) (ANSI/AWWA B302).
- D. AWWA B303 - Sodium Chlorite; American Water Works Association; 1995 (Revised) (ANSI/AWWA B303).
- E. AWWA C651 - Disinfecting Water Mains; American Water Works Association; 1992 (ANSI/AWWA C651).

1.04 SUBMITTALS: (See Section 31 12 01, 1.05)

- A. Test Reports: Indicate results comparative to specified requirements.
- B. Certificate: Certify that cleanliness of water distribution system meets or exceed specified requirements.
- C. Disinfection report:
 - 1. Type and form of disinfectant used.
 - 2. Date and time of disinfectant injection start and time of completion.
 - 3. Test locations.
 - 4. Initial and 24-hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
 - 5. Date and time of flushing start and completion.
 - 6. Disinfectant residual after flushing in ppm for each outlet tested.
- D. Bacteriological report:
 - 1. Date issued, project name, and testing laboratory name, address, and telephone number.
 - 2. Time and date of water sample collection.

3. Name of person collecting samples.
4. Test locations.
5. Initial and 24-hour disinfectant residuals in ppm for each outlet tested.
6. Coliform bacteria test results for each outlet tested.
7. Certification that water conforms, or fails to conform, to bacterial standards of NYS Department of Health.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with AWWA C651.

1.06 REGULATORY CERTIFICATION REQUIREMENTS

- A. Provide certificate of compliance from authority having jurisdiction indicating approval of water system. Provide written certification from Village Public Works Superintendent that water system has been tested for leakage and sterilized and disinfected in a manner satisfactory to the Health Department having jurisdiction, but in no event less stringent than that provided for in AWWA Standard for disinfecting water mains C601, latest issue. Hypochlorites and liquid chlorines used in disinfection shall conform to most recent AWWA Standards B300 and B301. Provide certification prior to Architect issuing final acceptance. No water main or pipes shall be placed into service until test results are provided documenting that the water system is bacteriologically safe.

PART 2 - PRODUCTS

2.01 DISINFECTION CHEMICALS

- A. Chemicals: AWWA B300, Hypochlorite, AWWA B301, Liquid Chlorine, AWWA B302, Ammonium Sulfate, and AWWA B303, Sodium Chlorite.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that piping system has been cleaned, inspected, and pressure tested.
- B. Schedule disinfecting activity to coordinate with start-up, testing, adjusting and balancing, demonstration procedures, including related systems.

3.02 EXECUTION

- A. Provide specific water main taps located adjacent to ends of main and attach required equipment to perform the work of this Section.
- B. Inject treatment disinfectant along with potable water into piping system. Chlorine shall be fed at a constant metered rate into the feed water so that the chlorine concentration will result in at least 50 milligrams per liter (parts per million) concentration. Chlorine required to produce .50 mg/l concentration per 100 feet of pipe shall be as follows: 4" - 0.33 Gal. of 1% chlorine solution, 6" - 0.73 Gal. of 1% Chlorine Solution; 8" - 1.30 Gal. After filling the main pipe with chlorine solution, open each service line and hydrant branch to fill them with the same chlorine solution. Test the solution as it is withdrawn from each point until at least 50 mg/l concentration is obtained.
- C. Maintain disinfectant in system for 24 hours. Read and record chlorine residual after the 24 hour contact time; Minimum allowable level shall be 20 ppm.

- D. Flush, circulate, and clean until required cleanliness is achieved; use municipal domestic water. After flushing, take 2 samples, one from the domestic service line at its connection to the building plumbing system and one from a hydrant remote from the domestic service connection. Submit these samples for bacteriological analysis. Submit test reports to the Architect. If the initial disinfection fails to produce acceptable results, the procedure shall be repeated until a satisfactory report is obtained.
- E. Temporary taps shall be excavated, shut off and abandoned following satisfactory quality test results. Replace permanent system devices removed for disinfection.

3.03 FIELD QUALITY CONTROL

- A. Test samples in accordance with AWWA C651.

3.04 CLEAN UP

- A. During the contract and at intervals as directed by the Architect and as the disinfection of water system is completed, clear the site extraneous materials and debris. Leave the site in a clean, safe, well draining, neat condition.

END OF SECTION

SECTION 33 30 01

SITE SANITARY

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. The extent of Sanitary work is shown on the drawings.
- B. Sanitary work includes, but is not limited to:
 - 1. Sanitary Manhole
 - 2. Concrete manhole adaptors
 - 3. Trenching and Backfilling
 - 4. Piping and jointing to five feet from exterior building face
 - 5. Connections to existing sanitary systems
 - 6. Cleanouts
 - 7. Concrete cradles, saddles and collars
 - 8. Clean Up
- C. Provide materials, labor, equipment and services required to accomplish related work in accordance with the drawings and specifications.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 32 13 01 - Site Concrete Work
- B. Section 33 11 01 - Water Distribution
- C. Section 33 40 01 - Storm Drainage

1.03 SUBMITTALS: (See Section 31 12 01, 1.05)

- A. Provide Manufacturer's Product Data (MPD) and Shop Drawings for:
 - 1. Precast Structure (Manholes): Also, certification that structures meet H-20 loading requirements specified.
 - 2. Pipe and jointing-MPD only
 - 3. Cleanouts-MPD only
 - 4. Concrete manhole adaptors
- B. Provide Material Certificates: Also, samples as noted.
 - 1. Granular Backfill: Sample
 - 2. 4000 psi concrete
- C. Provide Permits, Test Results, Certifications and Operator's Manuals as noted below:
 - 1. Permit and Notification Letter: Copy of each as required in 1.04 B and C, also 3.01 B below.
 - 2. Exfiltration Test Results: As required in 1.05 below.
 - 3. Certification: As required in 1.04 F and 3.06 below.

1.04 JOB CONDITIONS

- A. Job conditions in Section 33 40 01 apply.
- B. Sewer work shall conform to standards of applicable government authorities having jurisdiction. Obtain and pay for permits and approvals required by local authorities. Copy permit to Architect.
- C. Notify Village or County Engineer or applicable government authority having jurisdiction in writing two (2 wks.) weeks prior to start of work. Copy letter to Architect.
- D. Comply with NFPA 70 - National Electrical Code.
- E. Certification: The sanitary system must be installed and certified by a licensed county Plumber when required by municipal or state law.
- F. Construction Review: Notify the Architect when the sanitary sewer system is approximately 25%, 75% and 95% complete.

1.05 TESTING

- A. Notify Architect and Municipal Engineer a minimum of forty-eight (48 hrs.) hours in advance. Provide manuals, materials and labor to carry out testing in the presence of the Architect, Municipal Engineer and NYS Department of Environmental Conservation (DEC).
- B. Test sewer systems with an exfiltration test for a period of two (2) hours that meets the following requirements:
 - 1. Gravity Systems: Do not exceed a leakage rate of 10 gallons per inch of internal pipe diameter per mile per day with minimum 2 feet head, excluding manholes.
 - 2. When standards of government authorities having jurisdiction are different, such as allowing no leakage or requiring stricter leakage rates, conform to the stricter standards.
 - 3. Any leakage beyond limits described shall be located and repaired. Retest pipe to insure adequate performance of pipe.

PART 2 - PRODUCTS

2.01 SANITARY MANHOLE

- A. Shall conform to Section 33 40 01 - 2.02, A., 2.03, 2.05, and 2.06.
- B. Manhole frames and covers shall be Syracuse Casting Sales Corp. Pattern 1030, Neenah Foundry Co. R-1642 with Type "A" lid of Architect approved equal. Lid shall have raised lettering on the cover to designate "SANITARY SEWER". Frames and covers shall be machined to prohibit rocking.
- C. Pipes entering manhole shall have concrete manhole adaptors as manufactured by (CMA) FERNCO or Architect approved equal.

2.02 GRANULAR BACKFILL

- A. Backfill for piping and drainage structures shall be as specified in Section 31 12 01-2.01.

- B. Backfill for Absorption Trenches shall be washed, graded, angular gravel, free of shale, clay, friable materials and debris, sized 3/4 to 1-1/2 inches.

2.03 PIPING

- A. P.V.C. Gravity Sewer Pipe shall conform to ASTM D-3034, SDR 35. Joints shall be rubber flexible gasketed joints conforming to the ASTM F477.

2.04 CLEANOUT

Shall be ductile iron in paved areas. Standard of quality shall be Neenah or Architect approved equal. In non-paved areas, cleanout shall be PVC, compatible with gravity sewer pipe.

2.05 CONCRETE MATERIALS FOR STRUCTURE BASES, PIPE CRADLES, COLLARS, SADDLES

- A. Portland Cement: ASTM C 150, Type 1A.
- B. Aggregates: ASTM C33, coarse aggregate crushed limestone maximum size one inch (1"). Fine aggregate clean, sharp, natural sand.
- C. Water: Clean, drinkable.
- D. Air-Entraining Admixture: ASTM C 260, Darex or Architect approved equal.
- E. Ready Mix Concrete: ASTM C 94.
- F. Minimum Concrete Strength: Shall be 4,000 psi at 28 days; minimum cement content 6.5 bags/c.y., 4.0 gals./bag of cement; slump 1-1/2" to 3" provide air-entraining admixture 5-8-1/2%; flexural strength ASTM C 78 650 psi at 28 days.

PART 3 - EXECUTION

3.01 CONNECTIONS TO OTHER SANITARY SYSTEMS

- A. Connections at Building(s):
 - 1. Locate accurately per site and plumbing drawings. Verify inverts and sizes. Notify Architect of any discrepancies immediately, prior to installation.
 - 2. Install pipe and jointing to five (5') feet from the exterior building face.
 - 3. Cap end and mark.
 - 4. Connection will be made by the Plumbing Contractor.
- B. Connections to existing Sanitary Systems:
 - 1. Locate accurately per drawings. Verify inverts and sizes. Notify Architect of any discrepancies immediately, prior to installation. Coordinate with the Municipality and other agencies having jurisdiction.
 - 2. Notify governing agency in writing a minimum of two (2 weeks) weeks prior to anticipated date of connection. Copy letter to Architect.
 - 3. Connect the site sanitary system to the existing sanitary system. Make connections securely, watertight and as detailed.

3.02 TRENCHING AND BACKFILL

Shall be as described in Section 33 40 01-3.02.

3.03 MASONRY

Shall be as described in Section 33 40 01-3.03.

3.04 CASTINGS

Shall be as described in Section 33 40 01-3.04.

3.05 PIPE LAYING

- A. Bed pipe in granular backfill or concrete as shown on drawings, compact under springline of pipe to assure firm support. Align pipe to line and grade given in plan and profile. Set batter boards or set by laser level.
- B. Place backfill around pipes to equal depths on both sides as work progresses. Compact trenches to at least ninety-five (95%) percent maximum density as specified in Section 31 22 01.
- C. P.V.C. pipe push type joints shall be made using the flexible gaskets specified. Push together pipes so that the gasket is firmly seated in the socket.
- D. Ductile iron mechanical joints shall be securely tightened with gasket firmly seated to create a watertight joint.
- E. "Lamp" pipes to check for misalignment and breakage after backfilling has been completed. Replace pipes deviating more than 1/2" from line or grade at no additional cost to the Owner.
- F. Concrete cradles, saddles and collars: Refer to Section 32 13 01, Part 3.
- G. Conduct testing as described in 1.05 above.

3.06 CLEANOUT

Install as detailed. Construct flush with finished grade.

3.07 PROVIDE CERTIFICATION

Provide written certification from the Municipal Engineer that the sanitary work in the public right of way has been installed in a manner satisfactory to the governing agency having jurisdiction over the work. Provide certification prior to Architect issuing final acceptance.

3.08 CLEAN UP

During the contract and at intervals as directed by the Architect and as the sanitary sewer system is completed, clear the site of pipe, trench and backfill material, stone, concrete and debris. Leave the site in a clean, safe, well draining, and neat condition.

END OF SECTION

SECTION 33 40 01

STORM DRAINAGE

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. The extent of the storm drainage is shown on the drawings.
- B. Storm drainage work includes, but is not limited to:
 - 1. Trenching, backfilling and compaction
 - 2. Storm structures, castings, and appurtenances
 - 3. Piping, jointing and fittings
 - 4. Connection(s) to other storm system(s)
 - 5. Adjusting existing storm structures and other utilities
 - 6. Storm Water Management Trench (SMT)
 - 7. Storm Water Retention Structure(s)
 - 8. Sleeves and seals
 - 9. Vertical Drains
 - 10. Flat Drains
 - 11. Area Drains
 - 12. Quality Control Testing and Submittals
 - 13. Clean Up
- C. Provide materials, labor, equipment and services required to accomplish related work in accordance with the drawings and specifications.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 31 12 01 - Site Preparation
- B. Section 31 25 01 - Erosion, Sediment and Pollution Control
- C. Section 31 22 01 - Site Earthwork: For Elaboration of Shoring and Bracing, Dewatering, Backfilling, Compaction and Field Quality Control Testing.
- D. Section 32 12 01 - Asphalt Paving
- E. Section 32 13 01 - Site Concrete
- F. Section 33 11 01 - Water Distribution
- G. Section 33 30 01 - Sanitary

1.03 REFERENCES

- A. ASTM D2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewer and Other Gravity Flow Applications.

1.04 SUBMITTALS: (See Section 31 12 01, 1.05)

- A. Shop Drawings (SD) required for:

1. Precast concrete drainage structures showing sizes, elevations for openings and, HS20 loading certification.
 2. Storm Water Retention Structures
 3. Trench Drain and Trench Drain Catch Basin Layout
- B. Manufacturer's Product Data (MPD) required for:
1. Drainage structures and castings
 2. Pipe, joints and fittings
 3. Vertical Drains
 4. Flat Drains
 5. Area Drains
 6. Stormwater Management Trench for Pipes and Geotextiles
 7. Trench Drains, Trench Drain Catch Basins, and Grates
 8. Sleeves and seals
- C. Quality Control Submittals:
1. Provide trench drain as-built survey as described in "Quality Assurance" of this specification section.
 2. Provide a list of completed projects including Owner's contact information for each project, demonstrating compliance with applicable "Experience Requirements" specified in "Quality Assurance" of this specification section.
 3. Provide Infiltration Testing Report(s) for infiltration basins, infiltration trenches, drywells and bio-retention areas as described in "Quality Assurance" of this specification section. Stormwater facility design may be adjusted by Architect depending on results of tests.

1.05 QUALITY ASSURANCE

- A. When trench drain installation is complete verify the elevation of the trench drain by survey method with shots taken at ten (10') feet on center. Plot points and review with Architect prior to proceeding further.
- B. Drainage Contractor Experience Requirements:
1. Submit business name, business owner(s) name(s), business address, telephone number, website and/or email address signed by the Contractor/Subcontractor who meets the qualifications set forth in this specification and is proposed by the Contractor to perform the Drainage for this Project.
 2. Provide a list of at least four (4) Drainage work projects of comparable size, scope and quality completed successfully by the proposed Contractor/Subcontractor within the past three (3) years that includes the date completed, project Owner's name and current contact information, including telephone numbers and email addresses.
- C. Infiltration Testing Required by Contractor: (Subsurface Storage System, Drywells)
1. Perform eight (8) infiltration tests in locations as directed by the Architect and as detailed.

2. May be done through a boring or open excavation as described in NYSDEC, Division of Water, published in Standards of Wastewater Treatment Works, 1988 or latest revision.
3. Install casing (solid 4-6 inch diameter, 30" length) to 24" below finished grade.
4. Remove any solid surface and provide a natural soil interface into which water may percolate. Remove all loose material from the casing. Upon the tester's discretion, a two (2") inch layer of coarse sand or fine gravel may be placed to protect the bottom from scouring and sediment. Fill casing with *clean* water to a depth of 24" and allow to pre-soak for twenty-four hours.
5. Twenty-four hours later, refill casing with another 24" of clean water and monitor water level (measured drop from the top of the casing) for 1 hour. Repeat this procedure (filling the casing each time) three additional times, for a total of four observations. Upon tester's discretion, the final field rate may either be the average of the four observations, or the value of the last observation. The final rate shall be reported in *inches per hour*.
6. Upon completion of the testing, the casing shall be immediately pulled, and the test pit shall be backfilled and site restored.

1.06 JOB CONDITIONS

- A. Job conditions in Section 31 22 01 apply.
- B. Plan and execute piping work so that trenches are not opened for more than two hundred (200') feet in advance or left unfilled more than one hundred (100') feet behind. No overnight open excavation is permitted.
- C. CERTIFICATION OF STORM SYSTEM: The storm system must be installed and certified by a licensed County Plumber when required by municipal code or state law.
- D. CONSTRUCTION REVIEW: Notify the Architect when the storm system is approximately 25%, 50% and 95% complete.

1.07 SUBSTITUTIONS

- A. Contractor is responsible for design of any substituted structures, systems or units in Section 33 40 01 by a NYS licensed engineer. Submit to Architect for approval.
- B. If a product is being submitted as a substitution to the specified product; the Prime Contractor shall submit and request a product material substitution with his/her bid. The Prime Contractor shall at a minimum provide the following for review by the Architect and Owner:
 1. All submittals as specified herein
 2. Product comparison
 3. Cost Information (including proposal of change in Contract Sum)
 4. Contractor's certification that proposed substitution complies with requirements in the Contract Documents

5. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

PART 2 - PRODUCTS

2.01 BACKFILL

- A. Backfill for pipes, Stormwater Management Trenches (SMT) and drainage structures shall be as specified in Section 31 22 01.

2.02 STORM STRUCTURES AND CASTINGS

- A. Storm Inlets and Manholes:
 1. Shall be precast reinforced portland cement concrete conforming to the size(s) and shape shown on drawings, designed for AASHTO HS-20 loading. The materials and structural design of the structures shall be per ASTM C478 and ASTM A497, Grade 60. The minimum compressive strength of the concrete in the structure base, riser, and top section shall be 5,000 psi. The minimum wall thickness shall be one twelfth of the internal diameter of the riser or largest cone diameter. All joints shall be waterproofed with O-ring rubber gaskets and sealed with a mastic treatment in accordance with ASTM C990. Any grout used within the system shall meet the ASTM C 1107. Manhole connector holes shall be equipped with a seal gasket that meets or exceeds material specification of ASTM C-923 or other locally approved methods. Base units shall be extended. Standard of quality shall be as manufactured by Zeiser Wilbert, Jefferson Concrete, Fort Miller or Architect approved equal.
 2. Castings: Provide HS20 loading and bike safe grates, ductile iron meeting grade 65-45-12 as determined by ASTM A536-84, sizes as noted on the plans. Frames, covers and grates shall be machined to prohibit rocking. Standard of Quality shall be Neenah Foundry, East Jordan Iron Works, US Foundry, or Architect approved equal.
- B. Area Drain(s): Shall be a watertight PVC, HS-20 loaded drain basin with drop-in integral grates. Structures shall be able to accommodate all connecting pipes watertight. Refer to drawings for sizes and grate styles.
 1. 10" Standard light-duty drop-in grate.
 2. 30" Integral frame and ductile iron cover to match basin O.D.
 3. Standard of quality shall be Nyloplast as distributed by Advanced Drainage Systems, Inc., 800-821 6710, or Architect approved equal.
- C. Trench Drain and Trench Drain Catch Basin(s): (For inside track.)
 1. Trench Drain shall be fabricated of polymer concrete, 155 mm (6.1 in) and 249mm (9.8 in) deep with radius non-sloping bottom having the following attributes:
 - a. Length: 1000 mm (39.37 in).
 - b. Anchoring ribs: full length.
 - c. Slot channel.
 - d. Interlocking ends.
 - e. Provide end frames where needed.

- f. Sections shall be straight and radius
 - 2. Accessories:
 - a. Catch basins - System 2000 LW100 even slot drain series. Part No. 05620 with slot cover part No. 00788.
 - b. Plastic PVC trash buckets with removable slot cover.
 - 3. Standard of quality: shall be ACO SPORT SYSTEM 2000 LW100 slot channel, straight and radius sections and catch basins with PVC trash baskets as manufactured by ACO Drain and distributed by SportsField Specialties, Inc. 888-975-3343 or Architect approved equal.
- D. Trench Drain and Trench Drain Catch Basin (Standard Site Work):
- 1. Trench Drain shall be fabricated of polymer concrete, 150 mm (6 in) wide, 100 mm (4 in) ID and 166 mm (6.54 in) deep with radius non-sloping bottom having the following attributes:
 - a. Length: 1000 mm (39.37 in).
 - b. Anchoring ribs: full length.
 - c. Grate locking slots: blind, vibration dampening, thermoplastic.
 - d. Interlocking ends.
 - e. Provide end frames where needed.
 - 2. Grate: Fabricated of black polypropylene.
 - a. Full width transverse drainage openings.
 - 3. Accessories:
 - a. Locking devices
 - b. Catch basins - System 4000.
 - c. Trash buckets with removable galvanized steel trash baskets.
 - d. Grate removal tool (provide 2) Part # 13118
 - 4. Standard of quality: shall be ACO SPORT SYSTEM 4000 with grate #97393 catch basin with galvanized trash baskets as manufactured by SportsField Specialties, Inc. 888-975-3343 or Architect approved equal.

2.03 STORM STRUCTURE APPURTENANCES

- A. Precast Concrete Adjustment Rings: Shall be square or round depending on structure. Built in accordance to ASTM C478, and made of 5,000 psi concrete and reinforced steel, meeting ASTM A615 Grade 60, as manufactured by Fort Miller, Zeiser Wilbert, Jefferson Concrete or Architect approved equal.
- B. Steps: Shall be copolymer polypropylene plastic reinforced with 1/2" diameter grade 60 steel as manufactured by M.A. Industries or Architect approved equal.
- C. Mortar: Shall be lime, cement, and clean sand, 1:1:3 measured by volume, meeting ASTM C1107.

2.04 PIPING

- A. High Density Polyethylene Pipe (HDPE): Shall be heavy duty dual wall, high density polyethylene (HDPE) pipe conforming to ASTM F2648 for 4" to 60" pipe with a smooth inner wall, annular corrugations, "n" flow rating of 0.012, and HS-20 loading capability with minimum one (1') foot cover for 4" to 48" pipe and two (2') foot cover for 6-" pipe. Joint couplings for pipe shall be connected using a bell & spigot joint, meeting AASHTO M252, AASHTO M294, or ASTM F2306. The joint shall be soil tight and gaskets, when applicable, shall meet the requirements of ASTM F477. Standard of quality shall be N-12 Mega Green ST IB pipe as manufactured by Advanced Drainage Systems, Inc., 800-821 6710, or Architect approved equal.

2.05 STORM WATER MANAGEMENT TRENCH, TYPE 1 SERIES

- A. 4" to 10" Pipe: Shall be flexible, heavy duty, corrugated interior and exterior, perforated (or slotted) polyethylene pipe meeting requirements ASTM F-667 for 4" to 10" diameters. Standard of quality shall be ADS with prefabricated snap fittings as manufactured by Advanced Drainage Systems, Inc., (614) 457-3051 or Architect approved equal. Size pipe(s) as noted on drawings.
- B. 12" to 24" Pipe and Fittings: Shall be heavy duty polyethylene (HDPE), corrugated interior and exterior, perforated pipe meeting requirements AASHTO M252, AASHTO M294, Type C. Standard of quality shall be ADS with prefabricated fittings as manufactured by Advanced Drainage Systems, Inc., (614) 457-3051 or Architect approved equal. Size pipe(s) as noted on drawings.
- C. 4" to 12" Fittings: Shall be injection molded fittings with a smooth interior and exterior meeting requirements AASHTO M252 for 4" to 10" diameters, and ASTM M294 or ASTM F2306 for 12" diameter. Standard of quality as manufactured by Advanced Drainage Systems, Inc., (614) 457-3051 or Architect approved equal. Size pipe(s) as noted on drawings.
- D. Backfill: Shall be clean, washed No. 1 stone as indicated in Section 312201.
- E. Soil Separation Fabric: Shall be a commercially manufactured non- woven polypropylene filter fabric. Standard of quality shall be Mirafi 140N as manufactured by TenCate or Architect approved equal.

2.06 STORM WATER MANAGEMENT TRENCH, TYPE 2 SERIES

- A. 4" to 10" Pipe: Shall be flexible, heavy duty, corrugated interior and exterior, perforated (or slotted) polyethylene pipe meeting requirements ASTM F667 for 4" to 10" diameters. Standard of quality shall be ADS with prefabricated snap fittings as manufactured by Advanced Drainage Systems, Inc., (614) 457-3051 or Architect approved equal. Size pipe(s) as noted on drawings.
- B. 12" to 24" Pipe and Fittings: Shall be heavy duty polyethylene (HDPE), corrugated interior and exterior, perforated pipe meeting requirements AASHTO M252, AASHTO M294, Type C. Standard of quality shall be ADS with prefabricated fittings as manufactured by Advanced Drainage Systems, Inc., (614) 457-3051 or Architect approved equal. Size pipe(s) as noted on drawings.
- C. 4" to 12" Fittings: Shall be injection molded fittings with a smooth interior and exterior meeting requirements AASHTO M252 for 4" to 10" diameters, and ASTM M294 or ASTM F2306 for 12" diameter. Standard of quality as manufactured by Advanced Drainage

Systems, Inc., (614) 457-3051 or Architect approved equal. Size pipe(s) as noted on drawings.

- D. Backfill: Shall be No. 1 stone as indicated in Section 312201.
- E. Soil Separation Fabric: Shall be a commercially manufactured non-woven polypropylene filter fabric. Standard of quality shall be Mirafi 140N as manufactured by TenCate, or Architect approved equal.
- F. Contractor shall use a section of soil separation fabric for temporary protection of SMT Type 2 until directed to remove and dispose of by the Architect.

2.07 STORM WATER RETENTION STRUCTURES

A. Chamber Design:

- 1. Only stormwater chamber systems evaluated by a NYS licensed design engineer and found to meet AASHTO section 12.12 safety factors will be considered.
- 2. Stormwater chambers shall be designed in accordance with ASTM F 2418-16a or F 2922 Standard Specification for Polypropylene (PP) or Polyethylene (PE) Corrugated Wall Stormwater Collection Chambers
- 3. The structural design of the chambers, the structural backfill, and the installation requirements shall ensure that the load factors specified in the AASHTO LFRD bridge design specifications, section 12.12, are met for: 1) Long-duration dead loads and 2) Short-duration live loads, based on the AASHTO design truck with consideration for impact and multiple vehicle presences.
- 4. Stormwater chambers shall be designed, tested and allowable load configurations determined in accordance with ASTM F 2787, "Standard Practice for Structural Design of Thermoplastic Corrugated Wall Stormwater Collection Chambers". Load configurations shall include: 1) Instantaneous (<1 min) AASHTO design truck live load on minimum cover 2) Maximum permanent (75-yr) cover load and 3) Allowable cover with parked (1-week) AASHTO design truck.
- 5. Stormwater water retention structures standard of quality shall be:
 - a. StormTech SC-740

as manufactured by Advanced Drainage Systems, Inc., (614) 457-3051 or Architect approved equal.

B. Performance:

- 1. Upon request by the Architect or Owner, the chamber manufacturer shall submit a structural evaluation for approval before delivering chambers to the project site as follows:
 - a. The structural evaluation shall be sealed by a NYS licensed professional engineer.
 - b. The structural evaluation shall demonstrate that the safety factors are greater than or equal to 1.95 for dead load and 1.75 for live load, the minimum required by ASTM F 2787 and by sections 3 and 12.12 of the AASHTO LFRD bridge design specifications for thermoplastic pipe.

- c. The test derived creep modulus as specified in ASTM F 2922 shall be used for permanent dead load design except that it shall be the 75-year modulus used for design.
 3. Only mechanical and material properties that were determined in accordance with ASTM test methods shall be allowed for structural design of the chambers.
 4. Only chambers affixed with the ASTM F 2418-16a or F 2922 designation shall be considered as meeting ASTM F 2418-16a or F 2922.
 5. The contractor shall submit design summary by the manufacturer that demonstrates that the system is designed to convey peak flow rates without scour of foundation stone.
- C. Materials:
 1. Chamber:
 - a. Chambers shall be arch-shaped and shall be manufactured from virgin, impact-modified polypropylene or polyethylene copolymers.
 - b. Chamber rows shall provide continuous, unobstructed internal space with no internal support panels in order to provide ease of access for inspection and maintenance functions.
 - c. Inspection ports shall be installed and constructed per project plans. Note that inspection ports shall only be installed along the Treatment Row to allow for inspection of the sediment build up over time.
 - d. The chambers shall be open-bottomed.
 - e. The chamber shall incorporate an overlapping corrugation joint system to allow chamber rows of almost any length to be built. Chamber models may be cut at the job site to improve site optimization and reduce product waste.
 2. Chambers and end caps shall be produced at an ISO 9001 certified manufacturing facility.
 3. End Caps:
 - a. End caps shall be injection molded or roto molded from polyethylene or polypropylene resin and allow pipe connections with polyethylene pipe. End caps shall have a curved face capable of resisting typical horizontal and vertical loads.
 - b. All chamber rows shall be terminated with an end cap. End cap placement on end of chamber will vary depending on chamber model.
 - c. End caps may incorporate cutting guides to allow easy field cutting for various diameters of pipe. Cutting guides shall be located at both the top and bottom of each end cap.
 4. Manifold Piping:
 - a. Manifold piping shall be designed to ensure that peak flows are distributed to the rows of chambers without scour of foundation stone.
 - b. Manifold piping shall be of dual wall HDPE piping such that accepted equations of hydraulics can be used as a basis for design.
 5. Stone:

- a. The foundation, embedment and cover stone shall be in accordance with the chamber manufacturer's installation instructions.
- b. Foundation and Backfill for "SC" chambers shall be run of crusher limestone meeting the following gradation as determined by ASTM-C136 and AASHTO M145:

<u>Standard Sieve Sizes</u>	<u>Percent Passing By Weight</u>
2" or 50 mm	100%
1" or 25 mm	95 - 100%
1/2" or 12.5 mm	25 - 60%
#4 or 4.75 mm	0 - 10%
#8 or 2.36 mm	0 - 5%

6. Fabric:

- a. Fabric between the chamber bottom and the stone foundation located along the entire length of the Treatment Row and the first 14.5 ft of all inlet rows.
- b. Fabric shall be Mirafi 500X as manufactured by TenCate or Architect approved equal for sediment capture, filtration and scour protection.
- c. Fabric between the top of the Treatment Row chambers and the embedment stone and surrounding the entire chamber system shall be Mirafi 140N as manufactured by TenCate or Architect approved equal for filtration.
- d. If shown and labeled on the drawings, a non-reinforced 30 mil PVC liner with solvent welded seams will be installed around the entire system to prevent water migration. See manufacturer's Tech Sheet #2 for guidance on PVC liners for the system.

D. Stormwater Treatment Row:

- 1. The stormwater chamber system shall incorporate an Treatment Row for stormwater treatment and system maintenance. An Treatment Row is a chamber row enclosed in geotextile fabric for sediment capture and maintenance.
- 2. The Treatment Row shall remove a minimum of 80% of Total Suspended Solids (TSS), 80% Total Petroleum Hydrocarbons (TPH), 80% Suspended Sediment Concentration, 60% Total Phosphorus, and 605 Total Zinc as verified by 3rd party testing.
- 3. Stormwater treatment system inspection and maintenance shall be in accordance with the Operations and Maintenance (O&M) section of the Stormwater Pollution Prevention Plan (SWPPP) and the product manufacturer's published guidance.

E. Accessories:

- 1. Spacers can be used to obtain the required minimum spacing between chamber rows.
- 2. During construction inlet filters or pipe plugs on all inlet pipes to the stormwater chamber system shall be used to prevent construction sediment from entering the Treatment Row system. Pipe plugs to be removed once construction of the system is complete and no further construction sediment loading is expected.

- F. Imported Granular Backfill above Stormwater Retention Structures: Shall be as specified in Section 31 22 01, 2.01, B.

2.08 PIPE SLEEVE AND WATERPROOF SEALS

- A. Sleeves shall be constructed of steel with a waterstop and anchor collar, 2" minimum. Sleeve length shall equal foundation wall thickness. Waterproof seals shall be rubber. Standard of quality: shall be the Link Seal Wall Sleeve and Link Seal Gasket as manufactured by the Thunderline Corporation or Architect approved equal.

2.09 VERTICAL DRAIN

- A. Standard of quality: shall be filter-wrapped, flat underdrain J-Drain SWD-6 as manufactured by JDR Enterprises Inc. (800) 843-7569 or Architect approved equal.
- B. Provide the 6-4 Endout to connect the J-Drain to a 4" perforated pipe and solid wye coupler to the storm water management trench piping. Secure with PVC tape.
- C. Backfill: Shall be clean, coarse concrete sand, graded as indicated in Section 31 22 01.

2.10 FLAT DRAINS

- A. Shall be perforated filter-wrapped, oblong, 13" wide x 1.5" thick with internal bracing meeting ASTM D7001. All fittings shall be made of polyethylene with a min. cell classification of 424420C as defined and described in ASTM D 3350.
- B. Standard of quality shall be ADS Advanedge as manufactured by Advanced Drainage Systems, Inc., (Tel. 800-821-6710) or Architect approved equal.
- C. Provide the 12-4 Endout to connect the Flat Drain to a 4" perforated pipe that wye couples to the storm water management trench piping.
- D. Secure all connections using manufacturer recommended PVC tape at all joints.

PART 3 - EXECUTION

3.01 CONNECTIONS TO OTHER STORM SYSTEM

- A. Connections at Building(s):
 1. Locate accurately per site and plumbing drawings. Verify invert and sizes. Notify Architect of any discrepancies immediately, prior to installation.
 2. Install pipe and jointing to within five (5') feet of each building exterior. Install temporary plugs, cap end, mark above grade, and protect. Coordinate with Plumbing Contractor. Connection will be made by Plumbing Contractor.
 3. The Plumbing Contractor shall be responsible for connecting the building drains and leaders to the site storm system.
 4. Make connections securely, watertight and as detailed. Provide all necessary couplers and fittings to make connections.
- B. Connections to existing Storm Systems:

1. Coordinate with the Municipality and other agencies having jurisdiction. Notify governing agency in writing a minimum of two (2) weeks prior to anticipated date of connection so that field procedures and installation can be reviewed by a representative of the Municipality. Copy letter to Architect.
2. Locate accurately per drawings. Verify inverts and sizes. Notify Architect of any discrepancies immediately, prior to installation.
3. Make connections securely, watertight and as detailed. Provide all necessary couplers and fittings to make connections.

3.02 TRENCHING AND BACKFILL

- A. Reference: Refer to Section 31 22 01 for elaboration of shoring and bracing, supporting, rock, dewatering, and backfilling.
- B. Trenching:
 1. Remove material encountered to the depth shown on drawings and with a maximum width of fourteen (14") inches and a minimum of nine (9") inches each side of conduit springline as detailed. Provide safe shoring, sheeting, and bracing. Remove before backfilling. Backfill excess or over excavation as described in Section 312201 to proper line and grade. Compact to 95% density.
 2. When unsatisfactory soil materials are encountered at design elevations, immediately notify the Architect in writing via email. Continue as directed by the Architect. When conditions are not a result of Contractor's negligence, additional excavation may be directed by the Architect and paid for as a Change Order on a unit price basis in accordance with specification Section 31 22 01.
- C. Water: Remove from trenches; drain trenches and/or provide sump pits and pumping equipment as necessary to keep trenches stable and dry at no additional cost to the Owner.
- D. Soft Material in Trench Bottom: Dry out and stabilize or remove and replace with imported granular backfill material to achieve firm, stable foundation at no additional cost to the Owner.
- E. Rock: Remove boulders and rock within one (1'-0") foot of pipe. Provide one (1'-0") foot of granular backfill between rock and conduits at no additional cost to the Owner.
- F. Backfill: Conform to details on drawings and as specified. Compact backfill to a minimum 95% of optimum density.

3.03 STORM STRUCTURES INSTALLATION

- A. Pre-Cast Structures:
 1. Install with corresponding extended precast base section. Precast base units shall be modified in the factory to have the correct size openings for piping.
 2. Provide drainage structures as detailed, built to finished grades given. Backfill with imported granular backfill material around drainage structure and compact to 95% density to avoid settlement.

3. Mortaring: Thoroughly wet concrete risers before laying. Mortar joints. Joints shall be completely full and struck flush.
 4. Install any required steps in a continuous flight, avoiding any conflict with piping.
 5. Construct channels in base of storm structures for positive flow from inlet to outlet piping where detailed.
 6. Build completed structure to avoid any infiltration or exfiltration of water except at underdrains or storm water management trenches.
- B. Trench Drains and Trench Drain Catch Basins: Install as detailed, built to finish grades given. Securely anchor trench drain with reinforcing bars or other method while concrete is being poured. Provide manufacturer's representative on site to advise installation crew during initial stages of the process. Slope trench drain invert towards trench drain catch basin. Secure castings. Produce survey of trench drain as noted in "Quality Control Submittals" of this specification section.

3.04 CASTINGS

- A. Provide the type specified and shown on drawings. Build to the finish grade as shown on drawings.
- B. Set castings firmly. Loose or rocking castings shall be rejected by the Architect.
- C. Paint all installed castings (inside and outside) with two (2) coats of black rust inhibitive paint as directed by the Architect.

3.05 ADJUSTING EXISTING UTILITIES

Adjust existing utilities as necessary to maintain utility service and meet finished grade conditions. Existing utilities include but are not limited to; hydrants, water valves, gas valves, electric pull boxes and manholes, storm drainage structures, cable and telephone markers, fiber optic cables, sanitary cleanouts and manholes, and guy wires.

3.06 PIPE LAYING

- A. Shall be in accordance with ASTM D2321 and pipe manufacturer requirements.
- B. Bed pipe in granular backfill or concrete as shown on drawings, compact under springline of pipe to assure firm support. Align pipe to line and grade given in plan and profile. Set batter boards or set by laser level.
- C. Pipe joints shall be made using the flexible gaskets specified. Clean bell end of any debris and lubricate. Remove protective wrap from gasket. Do not allow lubricated section to touch dirt or backfill. Foreign matter could adhere to surface and compromise joint integrity. Push together pipes so that the gasket is firmly seated in the socket. Always push spigot end into bell, not bell end into spigot.
- D. Place backfill around pipes to equal depths on both sides as work progresses.
- E. "Lamp" pipes to check for misalignment and breakage after backfilling has been completed. Replace pipes deviating more than 1/2" from line or grade at no additional cost to the Owner.

3.07 CONCRETE CRADLES, SADDLES AND COLLARS

As specified in Section 32 13 01.

3.08 PIPE SLEEVE AND WATERPROOF SEAL

- A. Locate and install sleeves where indicated on the drawings. Maintain the same line and grade of the storm pipe. Coordinate the installation of the sleeve with the other contractors prior to installation.
- B. Provide the waterproof seal between sleeve and storm pipe. Installation shall be approved by the Architect before backfill is installed.

3.09 STORM WATER MANAGEMENT TRENCH

- A. Use only pipe which is undamaged and flexible (have not been exposed to direct sunlight for more than six (6) months causing brittleness, cracking or splitting prior to placement). Pipe shall be stored for at least twenty-four (24 hrs.) hours in an area having a minimum temperature of fifty (50) degrees F.
- B. Trenching: Remove material encountered to the depth shown on the drawings. Provide shoring, sheeting, and bracing as necessary for safety; remove before backfilling.
- C. Install continuous envelope of soil separation fabric around the backfill up to subgrade of finish material. Fill stone to proper elevation and wrap top. Overlap fabric minimum twenty-four (24") inches at top and joints. Secure fabric joints to prevent separation and infiltration of adjacent materials and separation of fabric.
- D. Install pipe sloped as shown on drawings.
- E. Compact backfill to maximum density of adjacent materials.

3.10 STORM WATER RETENTION STRUCTURES

- A. Locate, stabilize and protect areas prior to bed excavation. Delineate perimeter of beds with silt fence to keep silt and heavy equipment out.
- B. Chambers shall not be installed until the manufacturer's representative has completed a pre-construction meeting with installers.
- C. Install as detailed and according to manufacturer's recommendations. Do not use crushed or recycled concrete in the installation or for backfill on the installation. Compact backfill to maximum density of adjacent materials.
- D. Chambers are not to be backfilled with a dozer or an excavator situated over the chambers.
 - 1. Manufacturer recommends three backfill methods:
 - a. Stoneshooter located off the chamber bed.
 - b. Backfill as rows are built using an excavator on the foundation stone or subgrade.
 - c. Backfill from outside the excavation using a long boom hoe or excavator.
- E. The foundation stone shall be leveled and compacted prior to placing chambers.

- F. Joints between chambers shall be properly seated prior to placing chambers.
- G. Maintain minimum - nine (9") inches spacing between the chamber rows.
- H. Inlet and outlet manifolds must be inserted a minimum of twelve (12") inches into chamber end caps.
- I. Stone must be placed on the top center of the chamber to anchor the chambers in place and preserve row spacing.
- J. Continue protecting beds during and after installation until final acceptance. Prevent heavy equipment and stockpiled materials from crushing or damaging the units and misaligning the pipes. Remove and replace damaged units, pipes and materials. Do not incorporate damaged materials into any installation.

3.11 VERTICAL DRAINS

- A. Install the Vertical Drains at the intervals noted on the drawings. Securely attach ends of these composite drains into the perimeter collector header system. Provide all fittings for secure connections.
- B. The vertical drain trench shall be installed a minimum of 6" wide by 1'-6" deep minimum AFTER installation of the topsoil. The sand backfill shall be extended to the surface of the topsoil. All trench spoils shall NOT contaminate the installed topsoil.
- C. The entire surface of where the vertical drains have been installed shall be dragged and leveled out to a smooth, well draining condition.

3.12 FLAT DRAINS

- A. Install the Flat Drains at the intervals noted on the drawings. Securely attach ends of these composite drains into the perimeter collector header system with specified fittings.
- B. Secure all connections with PVC tape.

3.13 FIELD QUALITY CONTROL

- A. Density Testing: Perform all density testing for piping trenches and structure backfill as indicated in Section 31 22 01.

3.14 CLEAN UP

- A. During the contract and at intervals as directed by the Architect and as storm drainage is completed, clear the site of pipe, trench and backfill material, stone, concrete and debris. Leave the site in a clean, safe, well draining, neat condition.
- B. Clean drainage structures, storm water management trenches and pipes: Clean out sediment, rubbish, construction debris, and foreign objects thoroughly, immediately prior to final acceptance.

END OF SECTION

