PROJECT MANUAL

SAVANNAH CHATHAM COUNTY PUBLIC SCHOOL SYSTEM

C24-01 ATHLETIC FIELDS & FIELDHOUSE

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RFP SET, VOLUME 2

MAY 12. 2023

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DIVISIONS 11 - 33

SECTION 00 01 10

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SECTION 11 19 16 - DETENTION GUN LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Handgun lockers.

1.2 COORDINATION

A. Coordinate installation of anchorages for detention gun lockers. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors that are to be embedded in adjacent construction. Deliver such items to Project site in time for installation.

B. Coordinate size and location of recesses in wall construction to receive recessed detention gun lockers.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for detention gun lockers.

B. Shop Drawings: For detention gun lockers.

1. Include plans, elevations, sections, and attachment details.
2. Indicate locations, dimensions, and profiles of wall and floor reinforcements.
3. Indicate locations and installation details of built-in anchors.
4. Show elevations and indicate dimensions of detention gun lockers, preparations for receiving anchors, and locations of anchorage.
5. Show details of attachment of detention gun lockers to built-in anchors.

C. Samples for Initial Selection: For detention gun lockers with factory-applied color finishes.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Examination reports documenting inspections of substrates, areas, and conditions.

C. Anchor inspection reports documenting inspections of built-in and cast-in anchors.

D. Field quality-control reports documenting inspections of installed products.

1. Field quality-control certification signed by Contractor and Detention Specialist.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.7 FIELD CONDITIONS

A. Field Measurements: Verify openings for recessed detention gun lockers by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 HANDGUN LOCKERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide KI Spacesaver Wall Mounted Handgun Locker EDHGF04, or comparable product by one of the following:

1. American Jail Products L.L.C.
2. Maximum Security Products Corp.
3. Southern Folger Detention Equipment Company.
4. Tiffin Metal Products.

B. Cabinet: Minimum 25 inches wide by 14.125 inches high by 6.5 inches deep; formed from 0.134-inch nominal-thickness steel sheet. Line each compartment with mothproofed felt or nonabsorbing, closed-cell padding.

1. Compartments: Four.

C. Doors: Formed from same material as cabinet, supported by heavy-duty continuous bottom hinge.

D. Locks: Manufacturer’s standard; provide one lock for each compartment.

1. Lock Preparation: Prepare door panel to accept cylinder specified in Section 08 71 63 "Detention Door Hardware."

E. Mounting: Recessed, with mounting flange formed from same material as body.

F. Materials:

1. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, CS (Commercial Steel), Type B; suitable for exposed applications.
3. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, CS (Commercial Steel), Type B; free of scale, pitting, or surface defects; pickled and oiled.
4. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666 or ASTM A 240/A 240M, austenitic stainless steel, Type 304.

G. Finishes:

1. Steel Baked-Enamel or Powder-Coat Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.

a. Color and Gloss: As selected by Design Professional from manufacturer's full range.

2.2 FABRICATION

A. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Coordinate dimensions and attachment methods of detention gun lockers with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.

C. Shear and punch metals cleanly and accurately. Remove burrs.

D. Form and grind edges and corners to be free of sharp edges or rough areas.

E. Form metal in maximum lengths to minimize joints. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.

F. Weld corners and seams continuously to comply with referenced AWS standard and 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 exposed welds and surfaces smooth and blended at exposed connections, so that no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
5. Weld before finishing components to greatest extent possible. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

G. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure detention gun lockers rigidly in place and to support expected loads. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce formed-metal units as needed to attach and support other construction.

H. Cut, reinforce, drill, and tap detention gun lockers as indicated to receive hardware, fasteners, and similar items.

I. Form exposed work true to line and level with accurate angles, surfaces, and straight sharp edges.

J. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.

2.3 ACCESSORIES

A. Concealed Bolts: ASTM A 307, Grade A unless otherwise indicated.

B. Cast-in-Place Anchors in Concrete: Fabricated from corrosion-resistant materials capable of sustaining, without failure, a load equal to 4 times the load imposed, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified testing agency; of type indicated below.

1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed; hot-dip galvanized according to ASTM A 153/A 153M or ASTM F 2329/F 2329M.

C. Embedded Plate Anchors: Fabricated from mild steel shapes and plates, minimum 3/16 inch thick; with minimum 1/2-inch-diameter, headed studs welded to back of plate.

D. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

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 detention gun lockers.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations of detention gun lockers before detention gun locker installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of detention gun lockers.

D. Verify locations of detention gun lockers with those indicated on Shop Drawings.

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

3.2 INSTALLATION

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing detention gun lockers to in-place construction. Include threaded fasteners for concrete and masonry inserts and other connectors.

B. Cutting, Fitting, and Placement: Obtain manufacturer's written approval for cutting, drilling, and fitting required for installing detention gun lockers. Set detention gun lockers accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

C. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.

D. Adjust doors and latches of detention gun lockers to operate easily without binding. Verify that integral locking devices operate properly.

E. Assemble detention gun lockers requiring field assembly with security fasteners with no exposed fasteners on exposed faces and frames.

3.3 FIELD QUALITY CONTROL

A. Inspect installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.

B. Remove and replace detention work if inspections indicate that work does not comply with specified requirements. Remove malfunctioning units; replace with new units.

C. Perform additional inspections to determine compliance of replaced or additional work. Prepare inspection reports.

D. Prepare field quality-control certification, endorsed by Detention Specialist, that states installed products and their installation comply with requirements in the Contract Documents.

END OF SECTION 11 19 16

SECTION 11 23 00 - COMMERCIAL LAUNDRY EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specifications sections, apply to work of this Section.

1.2 DESCRIPTION OF WORK

A. Extent of commercial laundry equipment indicated on drawings and by provisions of this Section, including schedules and equipment lists associated with either drawings or this Section.

B. Types of equipment required for project include following:

1. Washer/Extractors.
2. Dryers.

C. Refer to Division 22 Sections for plumbing piping rough-in and final piping hook-ups to connect commercial laundry equipment; not work of this Section.

D. Refer to Division 26 Sections for electrical rough-in and final wiring hook-ups to connect commercial laundry equipment; not work of this Section.

1.3 QUALITY ASSURANCE

A. NSF Standards:

1. Comply with applicable National Sanitation Foundation standards and recommended criteria.
2. Provide each principal item of equipment with "Seal of Approval" by NSF.

B. UL Labels:

1. Where available, provide UL labels on prime electrical components of food service equipment.
2. Provide UL "recognized marking" on other items with electrical components, signifying listing by UL, where available.

C. NFPA Codes: Comply with NFPA No. 70 "National Electrical Code", and with NFPA No. 32 "Drycleaning Plants", and with NFPA No. 54 "National Fuel Gas Code".

D. Manufacturer: Firms regularly engaged in manufacture of commercial laundry equipment of types required, whose products in satisfactory use for min. period of five years.

1. Provide washer and dryer from same manufacturer.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's product specifications and installation instructions for each item; include rough-in dimensions, service connections, performances, power/fuel requirements, water/drainage requirements and similar information.

B. Shop Drawings: Submit roughing-in requirements drawings not later than 30 days after date established for commencement of the work of the project.

1. Provide cost for each piece of equipment for job site. This cost will be used to add or deduct equipment form work. Provide summary showing equipment, installation, or fit, and overhead.

C. Maintenance Manuals:

1. Submit bound manual for maintenance of commercial laundry equipment items.
2. For each item, including operating and cleaning/maintenance instructions, parts listing, recommended parts inventory listing, purchase source listing, copy of warranties, and similar applicable information.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Metals:

1. Stainless Steel: Except as otherwise indicated, provide AISI Type 304 or 302; no welding or brazing permitted on Type 302.
2. Galvanized Steel Sheet: ASTM A 526, except ASTM A 527 for extensive forming; ASTM A 525, G90 zinc coating, chemical treatment.
3. Where painted finish indicated, provide mill phosphatized treatment in lieu of chemical treatment.
4. Where factory-applied finish of porcelain or baked-on synthetic enamel indicated for exposed face of galvanized steel sheet, differentially coated sheet complying with ASTM A 525 may be provided at manufacturer's option.
5. Steel Sheet: ASTM A 569 hot-rolled carbon steel.
6. Steel Structural Members: Hot-rolled or cold-formed, carbon steel unless stainless steel indicated.
7. Galvanized Finish: ASTM A 123 hot-dipped zinc coating, applied after fabrication.

B. Paint and Coatings:

1. General: Provide durable, non-toxic, non-dusting, non-flaking, mildew resistant thermosetting types of painting and coating materials.
2. Shop Painting:
   a. Clean and prepare metal surfaces for painting; remove rust and dirt.
   b. Apply treatment to zinc-coated surfaces not mill-phosphatized.
   c. Coat welded and abraded areas of zinc-coated surfaces with galvanize repair paint.
   d. Apply manufacturer's standard metal enamel finish.
3. Bake primer (if any) and finish coatings in accordance with paint manufacturer's instructions for baked enamel finish.

C. Electrical Materials:

1. General: Provide standard materials, devices and components recommended by manufacturer/fabricator, selected and installed in accordance with NEMA standards and recommendations; and required for safe and efficient use and operation of equipment, without objectionable noise, vibration and unsanitary conditions.
2. Connections: Equip each item requiring electrical power with terminal box for permanent connection.
3. Power Characteristics:

   a. Refer to Division-26 sections for verification of project power characteristics.
   b. Also, refer to individual equipment requirements for loads and ratings.

4. Nameplates: Where possible, locate nameplates and labels on manufactured items in accessible position, but not within normal view.

2.2 EQUIPMENT DESCRIPTIONS

A. Products specified generally by manufacturer's catalog or model number with general description including capacities, services, accessories and similar requirements.

2.4 WASHER/EXTRACTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Milinor
2. Cissel
3. UniMac – RMG055 (Basis-of-design)

B. Provide washer/extractor with following characteristics and specifications:

1. Construction: Stainless steel tub, cylinder, front and door; galvanized sides; other structural parts coated with rust resistant coating.
2. Electrical interlock: Prevent door opening when machine in use.
3. Dynamic braking: Reduce cylinder speed rapidly after extraction cycle.
4. Thermometer: Fahrenheit and metric scales.
5. Temperature selector: Switch to select hot, warm or cool water.
6. Rinse cool-down: Multi-stage for permanent press; automatic fill without splashing load.
7. Vacuum breaker: Built-in.
8. Chemical dispenser; top mount
9. Supply injection: Equipment machine with front mounted two-hopper pocket; one pocket for manual admission of liquid or dry supplies, the other for automatic admission of only dry supplies during programmed cycle; program also capable of signaling for manual addition of supplies.
10. Manual override control: Provide switches for automatic or manual control of water temperatures, drain, stop and start.
11. Access: Controls, electrical and mechanical components generally accessible from front.
12. Dry weight capacity: 45 lbs.
13. High Extract rate: 400

2.5 DRYERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cissell Corp
2. Milinor
3. UniMac UT 055N (Basis-of-design)

B. Provide dryers equal to following:
1. Fuel: electric.
2. Dry weight capacity: 55 lbs.
3. Cylinder size: 33” x 35"
4. Operating Controls: Push button key-pad computer directed controls to sense fabric heat and display on LED screen, and monitor trouble any circuit.
5. Lint Screen: Self-cleaning lint screen which drops lint into storage area.
6. Cabinet: Baked enameled embossed or smooth steel, reinforced as required to prevent vibration or noise and fitted with extruded aluminum trim; removable pans to provide easy access to lint storage; adjustable feet for leveling.
7. Door: Gasketed heat resistant clear glass in metal frame; safety interlocked to prevent machine form operating when door not fully closed.

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION

A. Rough-In work:

1. Installer of commercial laundry equipment examine roughed-in mechanical and electrical services, and installation of floors, walls, columns and ceilings, and conditions under which work installed; and verify dimensions of services and substrates before beginning work.
2. Notify Contractor in writing of unsatisfactory locations and dimensions of other work, and of unsatisfactory conditions for proper installation of equipment.
3. Do not proceed with installation until unsatisfactory dimensions and conditions corrected in manner acceptable to Installer.

3.2 INSTALLATION

A. Service Lines and Equipment Connections:

1. Comply with applicable requirements of Division-22 sections for piping connections and piping systems.
2. Comply with applicable requirements of Division-26 Sections for electrical work including equipment connections.

B. Set each item of equipment securely in place, leveled and adjusted to correct height.

1. Anchor to supporting substrate where indicated and where required for sustained operation and use without shifting or dislocation.

2. Conceal anchorages where possible.
3. Adjust equipment to level tolerance of 1/16" max. Offset, and max. Variation from level or indicated slope of 1/16" per ft.
4. Shim and anchor washer - extractor per manufacturer's recommendations.

3.3 CLEANING, RESTORING FINISHES

A. After completion of installation, and completion of other major work in service areas, remove protective coverings, if any, and clean equipment, internally and externally.

1. Restore exposed and semi-exposed finished to remove abrasions and other damages; polish exposed-metal surfaces and touch-up painted surfaces.
2. Replace work not successfully restored.

B. Prior to date of Final Approval, buff exposed stainless-steel finishes lightly, using power buffer and polishing rouge or grit of No. 400 or finer.

3.4 TESTING, START-UP AND INSTRUCTIONS

A. General: Delay start-up of equipment until service lines tested, balanced, and adjusted for pressure, voltage, and similar considerations; and until water lines cleaned.

B. Test each item of operational equipment to demonstrate proper operation, and that controls and safety devices function properly.

1. Repair or replace equipment found defective in operation, including units below capacity or operating with excessive noise or vibration.

C. Instruct Owner's operating personnel in proper operation and maintenance procedures for each item of equipment.

D. Provide services of Installers technical representative, and manufacturer's technical representative where required, to instruct Owner's personnel in operation and maintenance of commercial laundry and dry-cleaning equipment.

E. Schedule training with Owner, provide at least 7-day notice to Contractor and Architect/Engineer of training date.

F. Provide instructional video tapes for Owner's permanent library describing operation and maintenance of system.

END OF SECTION 11 23 00

SECTION 11 30 13 - RESIDENTIAL APPLIANCES

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. Cooking appliances.
2. Kitchen exhaust ventilation.
3. Refrigeration appliances.
4. Cleaning appliances.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include installation details, material descriptions, dimensions of individual components, and finishes for each appliance.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

B. Product Schedule: For appliances. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranties: For manufacturers' special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.

1.6 WARRANTY

A. Special Warranties: Manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 1 year from date of Material Completion.

PART 2 - PRODUCTS

2.1 MATERIALS AND FABRICATION

A. Colors: Provide manufacturer's standard colors as shown or scheduled; if no color indicated, provide white.

1. Wherever residential equipment by more than one manufacturer installed in same space, provide units with color matching largest equipment item, unless otherwise indicated.

2.2 ELECTRIC RANGES (RNG)

A. 30” Freestanding Type:

1. Hinged, recessed, porcelain enamel cooktop.
2. 4 plug-in heating elements with infinitely adjustable controls, including not less than one 8”, 2600 watt element.
3. Removable porcelain enamel or chrome plated drip bowls.
4. Pyrolitic self-cleaning oven equipped with:

    a. Manually switched light.
    b. Door with window and safety locking feature.
    c. 2 adjustable chrome racks.
    d. Porcelain enamel broiler/roaster pan with chrome grille insert.

5. Control panel with clock, timer, and automatic oven controls.
6. Storage drawer below oven.
7. Adjustable legs.
8. Accessories/Options: Provide ranges with following additional features:

    a. Digital Clock.

9. Manufacturer: Subject to compliance with requirements, provide products of one of following:

    a. Frigidaire; White Consolidated Ind.
    b. General Electric.
    c. Hotpoint.
    d. Sears, Roebuck & Co.
    e. Whirlpool Home Appliances.
    f. White-Westinghouse.

2.3 REFRIGERATOR/FREEZERS (RF-1)

A. Manufacturer: Subject to compliance with requirements, provide products of one of following:

1. Amana Refrigerations, Inc.
2. Frigidaire; White Consolidated Ind.
3. General Electric.
4. Hotpoint.
5. Sears, Roebuck & Co.
6. Whirlpool Home Appliances.
7. White-Westinghouse.

B. Top Freezer Type

1. Freestanding, two-door.
2. Both compartments frostless, with separate temperature controls.
3. Switch for condensation control heating element at freezer opening.
4. Storage features including:

    a. Adjustable shelves.
    b. Meat compartment.
    c. Vegetable crisper(s).
    d. Butter conditioning compartment.
    e. Removable egg trays or bins.
    f. Door shelves.
    g. Min. 2 ice cube trays.

5. Reversible doors.
6. Adjustable rollers.
7. Capacity: Minimum values, measured according to ANSI B38.1 and certified by AHAM:

    a. Total volume: 20.0 cubic feet
    b. Refrigerator volume: 14.0 cubic feet
    c. Total shelf area: 25.0 square feet

8. Energy Consumption: Measured and certified as follows:

    a. Max. 150 kWh/month under average conditions.

9. Accessories/Options:

    a. Automatic icemaker.
    b. Adjustable tempered glass shelves in refrigerator.

2.4 DISHWASHERS (DW)

A. Built-in Type:

1. Undercounter automatic unit sized to replace 24” base cabinet.
2. Porcelain enamel interior and sound-absorbing exterior insulation.
3. Full-extension upper and lower racks.
4. Removable silverware basket.
5. Min. two wash cycles with min. two wash levels and food pulverizer.
6. Energy saving drying cycle.
7. Operable at water pressures from 20 to 120 psi.
8. Requiring max. 12.0 gallons of water for normal wash cycle.
9. Accessories/Options:

    a. Forced air drying cycle.
    b. Extra hot wash temperature selection.
    c. Push button controls.
    d. Adjustable upper rack.
    e. Automatic rinsing aid dispenser.

10. Finish: Provide following finish for door front and lower access panel:

    a. Manufacturer's standard, reversible panels providing min. choice of four colors.
    b. Black glass.
    c. Brushed chrome.
    d. 1/4” thick wood panel to match kitchen cabinets.

11. Manufacturer: Subject to compliance with requirements, provide products of one of following:

    a. Frigidaire; White Consolidated Ind.
    b. General Electric.
    c. Kitchen Aid Div.; Hobart.
    d. Hotpoint.
    e. In-Sink-Erator Div.; Emerson Electric.
    f. Sears, Roebuck & Co.
    g. Whirlpool Home Appliances.
    h. White-Westinghouse.

2.5 CLOTHES WASHERS (RW)

A. Automatic, Top or Front-Loading Type

1. 4.0 cubic feet capacity.
2. Top, lid, and tub of porcelain enamel on steel.
3. Controls as follows:

    a. Presettable metered fill-level.
    b. Presettable wash/rinse water temperatures.
    c. Variable speed cycle/fabric selector.

4. Removable lint filter.
5. Bleach and fabric softener dispensers.

6. Spin cycle safety switch.
7. Manufacturer: Subject to compliance with requirements, provide products of one of following:

    a. Frigidaire; White Consolidated Ind.
    b. General Electric.
    c. Hotpoint.
    d. Sears, Roebuck & Co.
    e. Whirlpool Home Appliances.
    f. White-Westinghouse.

2.6 CLOTHES DRYERS (RD)

A. All-Electric Type:

1. 220 volt 1 phase service with 5,000 W heat input.
2. 7.0 cubic feet capacity.
3. Timed cycle selection.
4. Fabrics selector.
5. Cycle end signal.
6. Safety starting control.
7. Removable lint filter.

B. Stackable Washer/Dryer:

1. 220 volt 1 phase service with 5,000 W heat input.
2. 7.0 cubic feet capacity.
3. Timed cycle selection.
4. Fabrics selector.
5. Cycle end signal.
6. Safety starting control.
7. Removable lint filter.

C. Manufacturer: Subject to compliance with requirements, provide products of one of following:

1. Frigidaire; White Consolidated Ind.
2. General Electric.
3. Hotpoint.
4. Sears, Roebuck & Co.
5. Whirlpool Home Appliances.
6. White-Westinghouse.

2.7 RANGES

A. Electric Range (RNG): Freestanding range with one oven(s) and complying with AHAM ER-1.

1. Manufacturer: Subject to compliance with requirements, provide products of one of following:

a. Frigidaire; White Consolidated Ind.
b. General Electric.
c. Hotpoint.
d. Sears, Roebuck & Co.
e. Whirlpool Home Appliances.
f. White-Westinghouse.

2. Width: As indicated on drawings.
3. Electric Burner Elements: Four.

a. Radiant Type: Two 1500 W and two 2000 W.
b. Controls: Digital panel controls, located on front.

4. Oven Features:

a. Operation: Baking convection and pyrolytic self-cleaning or catalytic continuous cleaning.
b. Broiler: Located in top of oven.
c. Oven Door(s): Counterbalanced, removable, with observation window full-width handle.
d. Electric Power Rating:

1) Oven(s): Manufacturer's standard.
2) Broiler: Manufacturer's standard.

e. Controls: Digital panel controls and timer display, located on front.

5. Anti-Tip Device: Manufacturer's standard.
6. Electric Power Supply: 240 V, 60 Hz, 1 phase, 30 A.
7. Material: Stainless steel with manufacturer's standard ceramic-glass cooktop.

a. Color/Finish: Black.

2.8 KITCHEN EXHAUST VENTILATION

A. Overhead Exhaust Hood (RHD)

1. Manufacturer: Subject to compliance with requirements, provide products of one of following:

a. Frigidaire; White Consolidated Ind.
b. General Electric.
c. Hotpoint.
d. Sears, Roebuck & Co.
e. Whirlpool Home Appliances.
f. White-Westinghouse.

2. Type: Wall-mounted.
3. Width: As indicated on Drawings.

4. Depth: 30 inches.
5. Exhaust Fan: Two speed fan built into hood and with manufacturer's standard capacity.

    a. Venting: As indicated on Drawings.
    b. Fan Control: Hood fan switch, with separate hood-light control switch.

6. Duct Type: Manufacturer's standard.
7. Finish: Stainless Steel.
8. Features:

    a. Permanent, washable stainless-steel mesh filter(s).
    b. Built-in halogen lighting.
    c. Warming lamp socket(s).

2.9 PERFORMANCE REQUIREMENTS

A. Electrical Appliances: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Gas-Fueled Appliances: Certified by a qualified testing agency for each type of gas-fueled appliance according to ANSI Z21 Series standards.

C. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with applicable provisions in the DOJ's 2010 ADA Standards for Accessible Design.

2.10 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.

C. Examine walls, ceilings, and roofs for suitable conditions where overhead exhaust hoods will be installed.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

3.2 INSTALLATION

A. Install appliances according to manufacturer's written instructions.

B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.

C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

D. Range Anti-Tip Device: Install at each range according to manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections :

1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After installation, start units to confirm proper operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.

B. An appliance will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.4 DEMONSTRATION

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

END OF SECTION 11 30 13

SECTION 11 40 00.13 – FOOD SERVICE EQUIPMENT

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. Ice machines.

B. Manufacturer's Qualifications: Firms regularly engaged in manufacture of food service equipment of types, capacities, and sizes required, whose products in satisfactory use in similar service for min. 5 years.

C. Installer's Qualifications: Firm with min. 3 years of successful installation experience on projects with food service equipment similar to that required for Project.

D. Codes and Standards:

1. NSF Standards:
   a. Comply with applicable National Sanitation Foundation standards and recommended criteria.
   b. Provide each principal manufactured or fabricated item of food service equipment with NSF “Seal of Approval”.

2. UL Labels:
   a. Where available, provide UL labels on prime electrical components of food service equipment.
   b. Provide UL “recognized marking” on other items with electrical components, signifying listing by UL, where available.

3. ANSI Standards: Comply with applicable ANSI standards for electrical-powered and gas-burning appliances, for piping to compressed gas cylinders, and for plumbing fittings including vacuum breakers and air gaps to prevent siphonage in water piping.

4. NFPA Codes: Install food service equipment in accordance with the following National Fire Protection Association (NFPA) Codes:

a. NFPA 70 – National Electrical Code.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include the following:

1. Manufacturer's model number.
2. Accessories and components that will be included for Project.
3. Clearance requirements for access and maintenance.
4. Utility service connections for water, drainage, power, and fuel; include roughing-in dimensions.

B. Shop Drawings: For fabricated equipment. Include plans, elevations, sections, roughing-in dimensions, fabrication details, utility service requirements, and attachments to other work.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For foodservice facilities.

1. Indicate locations of foodservice equipment and connections to utilities.
2. Key equipment using same designations as indicated on Drawings.
3. Include plans and elevations; clearance requirements for equipment access and maintenance; details of equipment supports; and utility service characteristics.

4. Include details of seismic bracing for equipment.

B. Sample Warranty: For special warranty.

C. Detailed Cost: Provide detailed information for each piece of equipment provide this as a cover sheet to each cut sheet. Separate cost of equipment for cost plus delivery FOB job site. Cost of labor to install of equipment as lump sum. Compiled summary sheet showing each piece of equipment with Design Professional’s mark number. submitted manufacture cost of equipment and separate labor lump sum. Provide project total cost of Profit overhead and miscellaneous expenses separate. Failure to provide with submit will result in rejection of complete submittal.

1.5 CLOSEOUT SUBMITTALS

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

1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

a. Product Schedule: For each foodservice equipment item, include the following:

1) Designation indicated on Drawings.

2) Manufacturer's name and model number.
3) List of factory-authorized service agencies including addresses and telephone numbers.

1.6 WARRANTY

A. General Warranty: Provide written warranty signed by Food Service Equipment Supplier/Installer and Contractor, agreeing to replace/repair, if notified within Two years after date of Final Acceptance, any equipment found inadequate due to defective materials, workmanship or installation, at no cost to Owner.

PART 2 – PRODUCTS

2.1 ICE MAKERS

A. Ice-Making Machine: Free Standing Ice Maker (IC-1)

1. Description: Freestanding units.

a. Basis of Design: Scotman C0330MA-1D.
b. Production: Ice cubes
c. Capacity: 400lb per 24-hour period.
d. Accessories:

1) Storage Bin: Required (included in basis of design model)

a) Storage Capacity: 344lbs.

2) Stainless steel stand and legs.

e. Electrical Service: Equip unit for connection to 6,23 kWh per 100lbs, 14.3 amps, 60 hertz, 1 Phase, 115V.

B. Ice-Making Machine: Flaked Ice Maker (IC-2)

1. Description: Freestanding units.

a. Basis of Design Hoshizaki F-330BAJ (C).
b. Production: Ice flakes.
c. Capacity: 300lbs per 24-hour period.
d. Accessories:

1) Storage Bin: 80lbs.

a) Storage Capacity:

2) Stainless steel stand and legs.
3) Water filter.

e. Electrical Service: Equip unit for connection to 5.91KW, 15AA Circuit, 6.9 Amps/115 Volts.

2.2 FINISHES

A. Stainless Steel Finishes:

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

a. Run grain of directional finishes with long dimension of each piece.
b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install foodservice equipment level and plumb, according to manufacturer's written instructions.

1. Connect equipment to utilities.

2. Provide cutouts in equipment, neatly formed, where required to run service lines through equipment to make final connections.

B. Install equipment with access and maintenance clearances that comply with manufacturer's written installation instructions and with requirements of authorities having jurisdiction.

3.2 CLEANING AND PROTECTING

A. After completing installation of equipment, repair damaged finishes.

B. Clean and adjust equipment as required to produce ready-for-use condition.

C. Protect equipment from damage during remainder of the construction period.

END OF SECTION 11 40 00.13

SECTION 11 52 03 - PROJECTION SCREENS

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. Electrically operated, front-projection screens.

B. Related Requirements:

1. Section 05 50 00 "Metal Fabrications" for metal support framing for front-projection screens.
2. Section 06 10 53 "Miscellaneous Rough Carpentry" for wood backing for screen installation.

1.3 DEFINITIONS

A. ALR: Ambient-light rejection; for specular reflective viewing surfaces, measured as the percentage of ambient light striking the viewing surface that has equal angles of incidence and reflection.

B. Gain: Ratio of light reflected from viewing-surface material to that reflected perpendicularly from a magnesium carbonate surface as determined in accordance with SMPTE RP 94.

C. Half-Gain Angle: The angle, measured from the axis of the viewing surface to the most central position on a perpendicular plane through the horizontal centerline of the viewing surface, where the gain is half of the peak gain.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show layouts and types of front-projection screens. Include the following:

1. Drop heights.
2. For electrically operated units, wiring diagrams and location of wiring connections.
3. Accessories.

C. Samples: For each type of exposed finish and for each color and finish specified, in manufacturer's standard sizes.

D. Product Schedule: For front-projection screens.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For front-projection screens to include in maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Environmental Limitations: Do not deliver front-projection screens until spaces are enclosed and weathertight, wet-work in installation spaces is complete and dry, and temporary or permanent HVAC system is operating and maintaining ambient temperature and humidity conditions planned for building occupants during the remainder of the construction period.

B. Store front-projection screens in manufacturer's protective packaging and according to manufacturer's written instructions.

1.7 COORDINATION

A. Coordinate layout and installation of front-projection screens with adjacent construction, including ceiling suspension systems, light fixtures, HVAC system components, fire-suppression system, and partitions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Projection Screens: Obtain each type of front-projection screen from single manufacturer. Obtain viewing surfaces and accessories, including mounting hardware, from screen manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Viewing-Surface and Masking Materials:

1. Mildew-Resistance Rating: Zero or 1 when tested in accordance with ASTM G21.
2. Flame Resistance: Passes NFPA 701.
3. Flame-Spread Index: Not greater than 75 when tested in accordance with ASTM E84.

2.3 ELECTRICALLY OPERATED, PROJECTION SCREENS

A. General Requirements: Manufacturer's standard units, consisting of case, screen, motor, controls, mounting accessories, and other components necessary for a complete installation. Provide units that are listed and labeled as an assembly by Underwriters Laboratories Inc. (UL) or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. 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. Screen Mounting: Top edge securely anchored to rigid metal roller and bottom edge formed into a pocket holding a metal rod, with ends of rod protected by plastic caps.

B. Surface-Mounted, Wood-Finished, Electrically Operated Screen: Motor-in-roller unit with tab-tensioned screen; with screen case with flat back, hardwood finish, and concealed mounting brackets for surface mounting on wall or ceiling, as indicated on Drawings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Da-Lite; a Legrand AV Inc. brand
    b. Draper, Inc.
    c. Steward Filmscreen

2. Motor in Roller: Instant-reversing motor of size and capacity recommended in writing by screen manufacturer; with permanently lubricated ball bearings, automatic thermal-overload protection, preset limit switches to automatically stop screen in up and down positions, and positive-stop action to prevent coasting. Mount motor inside roller with vibration isolators to reduce noise transmission.
3. Controls: Remote, key-operated, three-position control switch installed in recessed device box with flush cover plate.

    a. Provide with one control switch.
    b. Provide power supply for low-voltage systems if required.
    c. Provide locking cover plates for switches.
    d. Provide key-operated, power-supply switch.
    e. Provide infrared remote control, consisting of battery-powered transmitter and receiver.
    f. Provide video interface control for connecting to projector. Projector provides signal to raise or lower screen.

4. Screen-Case Hardwood: As selected by Architect from manufacturer's full range of species.

    a. Corners: Radiused or rectilinear.
    b. Finish: As selected by Architect from manufacturer's full range.

5. Tab Tensioning: Durable low-stretch cord, such as braided polyester, on each side of screen that is connected to edge of entire height of screen by tabs, to pull viewing surface flat horizontally.
6. Matte-White Viewing Surface: 1.0 minimum peak gain; material does not reach half-gain. Provide viewing surface without black backing.
7. Size of Viewing Surface:

    a. K-8 Platform: 96” x 144” (rear projection).
    b. Fieldhouse training room: 73.5" x 130.7" (front projection).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install front-projection screens at locations indicated on Drawings to comply with screen manufacturer's written instructions.

B. Install front-projection screens with screen cases in position and in relation to adjoining construction indicated. Securely anchor them to supporting substrate in a manner that produces a smoothly operating screen that, when lowered, has flat viewing surface and plumb vertical edges.

1. Install low-voltage controls in accordance with NFPA 70 and complying with manufacturer's written instructions.

    a. Wiring Method: Install wiring in raceway, except in accessible ceiling spaces and in gypsum board partitions, where unenclosed wiring method may be used. Use UL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables, except in unfinished spaces.

2. Test electrically operated units to verify that screen controls, limit switches, closures, and other operating components are in optimum functioning condition.
3. Test manually operated units to verify that screen-operating components are in optimum functioning condition.

END OF SECTION 11 52 13

SECTION 11 52 13 – OUTDOOR SPORTS EQUIPMENT

PART 1 – GENERAL

1.1 WORK INCLUDED

A. Provide equipment and materials and do work necessary to construct or provide the following as indicated on the Drawings and as specified. Work shall include but shall not be limited to:

1. Baseball/Softball Equipment:
   a. Foul Ball Poles.
   b. Bases, pitching rubber, home plate.
   c. Fence Top Rail Guard.

1.2 RELATED WORK

A. Related sections include:

1. Section 321823.20 - Infield Mix
2. Section 329110 - Amended Topsoil for Athletic Fields
3. Section 323113 - Chain Link Fences and Gates

1.3 SUBMITTALS

A. Shop Drawings:

1. Show application to project
2. Show fabrication and installation of foul ball poles, and Ball Net System. Include plans, elevations, component details, and attachments to other Work.

B. Product Data: Submit manufacturer's product data and samples as noted for the following:

1. Foul Ball Poles.
2. Bases, pitching rubber homeplate: Verify quantities which may include bullpens and batting tunnels.

1.4 QUALITY ASSURANCE

A. Installer of outdoor sports equipment and the playing fields shall be the same Contractor. All installed equipment shall be under the supervision of Owner's groundskeeper.

B. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code-Steel," and AWS D1.3, "Structural Welding Code – Sheet Steel."

1.5 WARRANTY

A. General Warranty: Special warranties specified in this Section shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranties:

1. Equipment: Written warranties, executed by the manufacturer of each piece of equipment specified agreeing to repair or replace equipment or components that fail in materials or workmanship with specified warranty period.

PART 2 – PRODUCTS

2.1 BASEBALL/SOFTBALL EQUIPMENT

A. Foul-Ball Poles:

1. Provide the following:
   a. Pole: Heavy-wall 4-inch OD aluminum pipe, 15-foot high above ground.
   b. Panel: 11 gauge, knuckled selvage chain link panel frames with heavy duty steel supports, 18 inches wide by 7 feet high.
   c. Finish: Electrostatically powder coated optical yellow.
   d. Product:
      1) LGFPW415 (Sportsfield Specialties).
      2) Or approved equal.
   e. Supplier:
      1) Sportsfield Specialties.
      2) C and H Baseball (941) 727-1533, www.chbaseball.com.
      3) Mid America Sports Advantage (800) 264-4519, www.masa.com.
      4) Or approved equal.

B. Bases, Plates and Rubbers:

1. Acceptable Products:
   a. Bases:
      1) Quantity: See Drawings.
      2) Hollywood Original Jack Corbett Bases with Anchors and Plugs.
      3) Or approved equal.
   b. Homeplate:
      1) Quantity: See Drawings.
      2) Schutt Bury All Rubber Homeplate.
      3) Or approved equal.
   c. Pitching Rubber:
      1) Quantity: See Drawings.

2) Regulation Hollywood 4 Way Official Size Pitching Plate.
3) Rubber with aluminum insert.
4) Or approved equal.

2. Suppliers:
   a. Beacon Ballfields, (800) 747-5985.
   b. Schutt Sports, (800) 426-9784.
   c. Mid America Sports Advantage (800) 264-4519, www.masa.com.
   d. Partac Peat, (800) 247-BEAM.

C. Dugout Benches:

1. General:
   a. Two-Tier.
   b. Polyboard Planking.
   c. 12 feet long (Use 2 per dugout).
2. Product:
   a. LG-BCHXXX.
3. Color: Dark Gray or as approved by Owner.
4. Supplier:
   a. Sportsfield Specialties, Inc. (www.sportsfieldspecialties.com).
   b. Or approved equal.

D. Fence Top Rail Guard:

1. Smooth poly, attach with clips to fence fabric, yellow or color as approved by Owner.
2. Product: Premium Fence Guard, Burbank.
3. Supplier:
   a. C and H Baseball (941) 727-1533, www.chbaseball.com.
   b. Burbank Sports Nets, (866) 349-0057, www.burbanksportsnets.com.
   c. Or approved equal.

PART 3 – EXECUTION

3.1 INSTALLATION

A. General: Install in accordance with manufacturers recommendations and approved shop drawings.

B. Baseball/Softball Equipment:

1. Foul Ball Poles and Appurtenances:
   a. Install as recommended by the manufacturer or as shown on the Drawings.
   b. The Contractor shall verify and install homeplate so that the back corner of the plate is at a 90-degree angle and lined up on the outside edge of the foul ball pole.

This location shall be verified by the Contractor at the beginning of playing field construction.

2. Bases, Plates and Rubbers:
   a. Install pitcher's plates, full depth homeplates, and bases as per the manufacturer's instructions.
   b. These operations to be done under the observance of the Team or Owner's Head Groundskeeper

END OF SECTION 11 52 13

SECTION 11 68 33 – OUTDOOR STADIUM EQUIPMENT

PART 1 – GENERAL

1.1 WORK INCLUDED

A. Provide equipment and materials and do work necessary and construct or provide the following as indicated on the Drawings and as specified. Work shall include but shall not be limited to:

1. Football Equipment:
    a. Goal post system
    b. Goal post pads
    c. Inline Fabricated Ball Net System.

1.2 SUBMITTALS

A. Shop Drawings:

1. Show application to project.

B. Product Data: Submit manufacturer's product data and samples as noted for the following:

1. Football Goal Post System

C. Provide sealed structural drawings by the qualified professional engineer for goalpost footings.

D. Provide sealed structural drawings by the qualified professional engineer for Ball Net System footings.

1.3 PERFORMANCE REQUIREMENTS

A. Inline Ball Net and Barrier Systems: Contractor to submit signed and sealed shop drawings by a State Licensed Engineer for the upright post diameter and footing design.

1.4 QUALITY ASSURANCE

A. Installer of outdoor sports equipment and the playing field shall be the same Contractor. All installed equipment shall be under the supervision of Owner's groundskeeper.

B. Inline Ball Net System Installer: Contractor to re-stretch/tighten netting if necessary 60 days after substantial completion.

C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code-Steel," and AWS D1.3, "Structural Welding Code – Sheet Steel."

1.5 WARRANTY

A. General Warranty: Special warranties specified in this Section shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranties:

1. Equipment: Written warranties, executed by the manufacturer of each piece of equipment specified agreeing to repair or replace equipment or components that fail in materials or workmanship with specified warranty period.
2. Impact and Barrier Netting: Installed netting shall prevent passage of kicked, struck or thrown balls or implements per designed sport use. If netting fails to do so, installer shall adjust netting to appropriate tension.
    a. Warranty Period: Per the manufacturer.

PART 2 – PRODUCTS

2.1 FOOTBALL EQUIPMENT

A. Football Goal Post System:

1. Goal Posts and Appurtenances for the specific sport level by the following or approved equal:
    a. Single Ground Sleeve Insert Gooseneck Support: Fabricated of 6” Schedule 40 Aluminum Pipe (6.625” O.D.), 5’ Radius, 8’ Offset
    b. Ground Sleeve: Fabricated of 8” Schedule 40 Steel Pipe (8” I.D.)
        1) Length: 60”
    c. Crossbar: Fabricated of 6” Schedule 40 Aluminum Pipe (6.625” O.D.)
        1) Length: 23’-4” – High School
        2) Includes feature allowing for easy installation through the adjustment of an internal locking rotating sleeve at both the gooseneck/crossbar and upright/crossbar connections.
    d. Uprights: Fabricated of Extruded 6061-T6 Aluminum Tube (4” O.D.) with Rigid Wire Loop Welded to Upper End
        1) Length: 20’
2. Goal Post Pads:
    a. 18 oz. Vinyl with Polyester.
    b. Scrim and Vertically Sewn in Hook and Loop Securement.
    c. Standard 6’ in Height
    d. Standard Vinyl Colors
    e. Custom Digitally Printed Lettering and/or Graphics
3. Products and Suppliers:
    a. Sportsfield Specialties, Inc. (www.sportsfieldspecialties.com):
        1) Goal System, Model No. GP820HS
        2) Foundation Box and Cover, Model No. GPAFNG.

3) Goal Post Pads, Model No. GPPRDG, 18 ounce.
b. Triman Tele-Goal (800) 822-6886.
c. Gilman Gear [Select appropriate goalpost]:
1) LNG23 (23 feet 4 inches wide), 8-foot offset, Gilman Gear.
d. UCS Sports and Recreation Equipment:
1) 8-foot offset.
2) (800) 526-4856.
e. Or approved equal.

4. Paint:
a. Powder Coated Saturn Yellow.

B. Inline Fabricated Ball Net System:

1. General:
a. Framing System:
1) Refer to Specification Section "Chain Link Fence and Gates" and Contract Drawings for lower fencing, upright posts, and footings
2) Contractor to submit sealed engineering drawings verifying footing and upright post diameters/sizes.
b. Height:
1) Total height of netting system as shown on drawings complete with pulleys, pull strings, connectors, cleats, etc., per recommendations of the manufacturer.
c. Netting System:
1) Provide:
a) Four-inch square mesh.
b) Twisted, knotted nylon netting.
c) Minimum Strength: 350 pounds.
d) Edge treatment: Hemmed with a 5/16-inch, three-strand twisted polyethylene rope spliced to the edge.
e) Weather treatment: UV and weather treated black netting and cord.
f) Cables, pulleys, accessories, etc., per drawing and manufacturers recommendations.
2) Netting shall be sized so that when installed it shall be fastened tight, with no slack at top of chain link fence rail. Contractor shall retighten after 60 days.

2. Netting and hardware Suppliers:
a. Keeper Goals, (800) 594-5126, keepergoals.com (preference).
b. Burbank Sports Nets, (866) 349-0057.
c. West Coast Netting, Inc., www.westcoastnetting.com (888) 631-6387.
d. US Netting, www.usnetting.com.
e. Carron Net, (800) 558-7768, www.carronnet.com.
f. Or approved equal.

PART 3 – EXECUTION

3.1 INSTALLATION

A. General: Install in accordance with manufacturers recommendations and approved shop drawings.

B. Football Equipment:

1. Inline Fabricated Ball Net System:
   a. Inline netting system and uprights to be in place and approved prior to beginning this installation.
   b. Install netting, pulleys, quick-clip net connects, nets and other appurtenances per manufacturer's recommendations.
   c. Use nylon ties to fasten netting to top of lower fence. Space per recommendation of manufacturer or no less than 18 inches on center.
   d. Contractor to return after 60 days to retighten netting as required.

END OF SECTION 11 68 33

SECTION 11 68 33.43 – TRACK AND FIELD EQUIPMENT

PART 1 – GENERAL

1.1 SUMMARY

A. This section covers all labor and materials required to install the following:

1. In-ground track and field equipment.
2. Field event materials.
    a. Sand.

B. The Contractor is responsible for the purchase and installation of all sports equipment. The Track & Field Synthetic Surfacing Contractor is responsible for installation of synthetic surface in, around and on top of the specified sports equipment.

1.2 CODES AND STANDARDS

A. Codes and standards follow the current guidelines set forth by the National Federation of State High School Associations (NFSHSA).

1.3 SUBMITTALS

A. The following information shall be submitted prior to installation of specified work.

1. Standard printed specifications and diagrams or drawings depicting installation directions and dimensions for all in-ground sports equipment.
2. Installation process and requirements for subbase (stone and asphalt) and any conditions that may limit the installation or affect quality of installation.
3. Material safety data sheets on all products, as necessary.
4. Contractor to supply Owner with a 1-gallon sample of field event material product(s) for visual inspection and testing.
5. Shop drawings shall be prepared for the track and field protective netting system showing all pertinent information regarding materials, assembly and installation. Submit drawings showing sizes and details of all equipment component parts.

1.4 QUALITY ASSURANCE

A. The Contractor shall only accept bids from those vendors or manufacturers that have been pre-approved or identified as approved equivalent.

B. The Contractor shall only accept bids from those vendors or manufacturers that have been pre-approved, identified as approved equivalent or that meet the requirements as an equivalent product.

PART 2 – PRODUCTS

2.1 IN-GROUND TRACK & FIELD EQUIPMENT

A. The Contractor is responsible to provide and install all permanent, in-ground track & field event equipment as specified by these specifications and shown on the project drawings. The products must meet NFSHSA regulations.

B. The physical make-up of these products vary across the country; therefore the Contractor shall use his best efforts to supply the Owner with a product that best meets the performance specifications listed below.

C. The in-ground track & field equipment is available from the following:

1. Sportsfield Specialties: Contact: Brian Jaeger (Southeast) Tel.: (607) 267-3621.
2. UCS Spirit: Contact: Mike Chappell; Telephone: (800) 526-4856.
3. Gill Athletics: Contact: Mike Cunningham; Telephone: (800) 637-3090.

D. In-ground Equipment (Based on Sportsfield Specialties Model # or Approved Equivalent)

1. Groves HS:
   a. Two (2) cast aluminum pole vault boxes without the cover. Model # PVBCAW.
   b. Two (2) mesh covers for sand pits. Model # SPCVRMCSTM.
   c. Four (4) 8" wide in ground take off boards with blanking lids. Model #LJJTOB8BL

2.2 FIELD EVENT MATERIALS

A. Sand:

1. The sand shall be washed and sized as follows:
   a. 2008 IAAF Track & Field Facilities Manual (2.3.1.5):
      1) For the safety of the athletes, the sand must (to avoid hardening as a result of moisture) consist of washed river sand or pure quartz sand, without organic components, maximum 2mm granules, of which not more than 5% in weight is less than 0.2mm.
2. Sand shall be free of trash, organic matter, clay, silt, and rocks.
   a. Top 6” of Sand color to be white.
3. Sand shall have the following technical data:
   a. Water permeability or filtration rate with a minimum of 20 inches/hour.
   b. Bulk density of 1.55 grams per cubic centimeter.
   c. Penetrometer Reading of 1.8 to 2.2 kg/cm^2.
   d. Sand shape of high sphericity and rounded.

PART 3 – EXECUTION

3.1 INSTALLATION OF SPORTS EQUIPMENT

A. The installation of the track and field equipment stated herein shall follow the directions of the manufacturer and/or vendor. Shop drawings must be submitted and approved prior to installation of equipment.

B. Sand:
1. The sand should be one of the last items installed on the facility to maintain the physical properties.
2. Do not install the sand until drain pipe is installed and connected to drainage system.

3.2 ADJUSTING AND CLEANING

A. Upon completion of installation, test operation to demonstrate satisfactory operation acceptable to Owner.

B. Clean or replace unsuitable materials.

END OF SECTION 11 68 33.43

SECTION 11 68 43 – OUTDOOR SCOREBOARD

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Provide and install one Outdoor LED Multisport Scoring and Video Screen at the football stadium and three Baseball/Softball scoreboards with wireless controllers, receiver/transmitters, carrying cases and horns. The Multisport Scoring and Video Screen shall provide timing and scoring for two team in the sports of football, soccer, lacrosse, and track. The Baseball/Softball scoreboards shall provide timing and scoring for two teams in the sports of baseball/softball.

B. Provide and install two football delay of game timing devices with wireless controllers and support post padding.

1.2 REFERENCES

A. The following references shall be applicable:

1. ETL listed to Standard for Electric Signs, UL-48.
2. ETL listed to Standard for Control Centers for Changing Message Type Signs, UL-1433.
3. Tested to CSA standards and CE labeled for outdoor use.
4. Standard for CAN/CSA C22.2.
5. Federal Communications Commission Regulation Part 15.
6. National Electric Code.

1.3 SUBMITTALS

A. Product data: Submit manufacturer’s product illustrations, data and literature that fully describe the scoreboards and accessories proposed for installation.

B. Shop drawings: Submit mechanical and electrical drawings.

C. Engineered stamped drawings: Submit stamped drawings by a State of Georgia Registered Professional Structural Engineer for sizing and construction of I-beam supports and foundations for the Outdoor LED Multisport Scoring and Video Screen.

D. Maintenance data: Submit manufacturer’s installation, operation, and maintenance manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Product delivered on site.

B. Scoreboard and equipment to be housed in a clean, dry environment.

1.5 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 weight and windload in addition to the auxiliary equipment.

D. Installation may proceed within acceptable weather conditions.

1.6 QUALITY ASSURANCE

A. All scoreboards shall be manufactured for outdoor use.

B. Source Limitations: Obtain each type of scoring or related equipment through one source from a single manufacturer.

C. ETL listed to UL Standards 48 and 1433.

D. NEC compliant.

E. FCC compliant.

F. ETLC listed to CAN/CSA 22.2.

1.7 WARRANTY/SERVICE PLAN

A. Provide 10 years of warranty coverage for the multisport scoring and video screen including 2 years onsite warranty.

B. Provide 5 years of warranty coverage for baseball/softball scoreboards.

C. Provide an exchange program to supply replacement parts for components that fail during the coverage period. To minimize downtime, the exchange parts will be shipped on the same day the order is received or on the following day. The manufacturer will also enclose an air bill for return of the defective components.

D. Provide access to a local Authorized Service Company.

E. Provide a help desk staffed by experience technicians and coordinators who are thoroughly familiar with the scoreboard and available for technical support. This staff must be available at no additional cost to the customer and provide an "on-call" service during weekends.

PART 2 – PRODUCTS

2.1 MANUFACTURER

A. The following approved manufacturers are:

1. Formetco, Inc., 2963 Pleasant Hill Road, Duluth, Georgia 30096, 1-800-367-6382, www.formetco.com
2. Daktronics, Inc., 331 32nd Avenue, P.O. Box 5128, Brookings, South Dakota 57006-5128, 1-800-325-8766, www.daktronics.com
3. Electro-Mech Scoreboard Co., 72 Industrial Blvd. • Wrightsville, GA 31096, 1-800-445-7856, www.electro-mech.com
4. All American Score Boards, 401 S. Main Street, Panderville, WI 53954, www.allamericanscoreboards.com
5. Fair Play Scoreboards, 1900 Delaware Ave., Des Moines, IA 50317, 1-800-247-0265, sales@fair-play.com
6. Or approved equal.

2.2 PRODUCT

A. Outdoor Multisport Scoring and Video Screen, single-sided, 16mm LED full matrix screen (300 pixels high x 540 pixels wide) shall provide times and scores for the sports of football, soccer, lacrosse, and track. It shall display period time to 99:59, 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. During the last minute of the period the clock displays time to 1/10 of second.

1. Approved manufacturer(s):

a. Model FTX-A2 Multisport Scoring and Video Screen by Formetco.

b. Or approved equal.

B. Outdoor Baseball/Softball scoreboards, typical of 3, single-sided baseball scoreboard displays HOME and GUEST team scores for up to nine innings, total RUNS to 99 for each team, AT BAT to 99, BALL to three, STRIKE to two and OUT to two. Scoreboard can show TIME or PITCH COUNT instead of AT BAT with included reversible caption panel.

1. Approved manufacturer(s):
   a. Model BA-2005 Scoreboard by Daktronics.
   b. Or approved equal.

C. Single-sided play clock/timing display configured to count up or down from any preset number from 0 to 99.

1. Approved manufacturer(s):
   a. Single side 4' x 4' LED wireless DOG (delay of game) clocks by Formetco.
   b. Or approved equal.

2.3 SCOREBOARD

A. General information:

1. Dimensions:
   a. LED video screen size with 6" trim 16 feet 9.75 inches high, 29 feet 5 inches wide (screen active area 15 feet 9 inches high, 28 feet 4.25 inches wide) Multisport
   b. 6 feet 6 inches high, 20 feet 0 inches wide, 0 feet 8 inches deep Baseball/Softball
   c. 7,500 pounds Multisport.
   d. 600 pounds Baseball/Softball.

2. Power requirement:

   a. Multisport 240V AC, 51.8 amps, 12,420 W.
   b. Baseball/Softball 120V AC, 2.4 amps, 260 W.

3. Color: To be selected and approved by Owner.

B. Construction:

1. Aluminum alloy 5052 construction per ASTM B221.
2. 100 percent solid state electronics housed in all aluminum cabinet.
3. LED color:
   a. Red/Green/Blue Multisport
   b. Amber Baseball/Softball

C. Captions:

1. Baseball/Softball:
   a. Vinyl applied directly to scoreboard face; TIME and PITCH COUNT on changeable caption panel
   b. HOME and GUEST captions: 12" high
   c. AT BAT/TIME/PITCH COUNT, BALL, STRIKE, and OUT captions: 10" high
   d. Inning numbers and RUNS captions: 8" high
   e. Color: standard white or others available upon request

D. Required Equipment:

1. Multisport
   a. Video processer hardware
   b. Video screen content controller hardware with digital media player, mouse, keyboard, and 24" monitor
   c. Scoring Console with handswitch
   d. Control room accessories, rack, cables, connectors
   e. Input switcher with instant replay
   f. Aluminum non illuminated top truss and identification panel with school name and logos (2), 4 feet high, 29 feet five inches wide.
2. Baseball/Softball
   a. Carrying case for control console.
   b. Scoreboard border striping.
   c. Protective screen for LED digits.
   d. Hardware for suspension installation.
   e. Horn.

2.4 SINGLE SIDED PLAY CLOCK/TIMING DISPLAY

A. General information

1. Dimensions: 4 feet high, 4 feet wide
2. Color: semi-gloss black
3. Wireless with hand controller

B. Play Clock Support Post Padding

1. I-Beam Post Padding:
   a. Square design x 4-ft height (verify in field)
   b. Premium fully encased construction
   c. 2” high density foam and outdoor vinyl
   d. Standard vinyl colors

2. Products and Suppliers:
   a. Sportsfield Specialties, Inc. (www.sportsfieldspecialties.com)
      Model #SBP6 (6” max. inside dimension – verify in field)
   b. Or approved equal.

2.5 BASEBALL/SOFTBALL SCORING CONSOLE

A. Console is an All Sport® 5000 controller or approved equal

B. Scores multiple sports using changeable keyboard inserts

C. Controls multiple scoreboards and displays, including other All Sport 5000 controlled displays currently owned by customer

D. Recalls clock, score, and period information if power is lost

E. Runs Time of Day and Segment Timer modes

F. Console includes:

1. Rugged aluminum enclosure to house electronics
2. Sealed membrane water-resistant keyboard
3. 32-character LCD to verify entries and recall information currently displayed
4. Power cord that plugs into a standard grounded outlet; 6 watts max
5. Control cable to connect to the control receptacle junction box (wired system only)
6. Hand-held switch for main clock start/stop and horn
7. Soft-sided carrying case

G. Accessory Equipment

1. 2.4 GHz spread spectrum radio system with frequency hopping technology and 64 non-interfering channels; system includes a transmitter installed inside the console and a receiver installed inside the scoreboard(s)
2. Hard carrying case
3. Battery pack

2.6 PROTECTIVE EQUIPMENT

A. Protective Netting:

1. Provide high protective netting for each Baseball/Softball scoreboard, respectively.

PART 3 – EXECUTION

3.1 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.

3.2 INSTALLATION

A. All power and control cables to scoreboards and displays will be routed in conduit, power to the scoreboards/displays as well as raceways shown on electrical plans by the Electrical Contractor. Scoreboard control wiring including conduit will be the responsibility of the contractor assigned the scoreboard equipment.

B. Install scoreboards and exterior displays to beams in location detailed and in accordance with manufacturer's instructions. Verify unit is plumb and level.

3.3 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.

END OF SECTION 11 68 43

SECTION 12 24 13 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Manually operated roller shades with single rollers.
2. Motor-operated roller shades with single rollers.

B. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

1. Motor-Operated Shades: Include details of installation and diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified, 10 inches long.

D. Product Schedule: For roller shades.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.

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. Roller Shades: Full-size units equal to 5 percent of quantity installed for each size, color, and shadeband material indicated, but no fewer than two units.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Design Professional of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

A. Subject to compliance with requirements, provide products from one of the following manufacturers:

1. Draper, Inc.
2. MechoShade Systems, LLC
3. Springs Window Fashions

B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

1. Bead Chains: Manufacturer's standard.

a. Loop Length: Full length of roller shade.
b. Limit Stops: Provide upper and lower ball stops.
c. Chain-Retainer Type: Clip, jamb mount.

2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller shade weight and for lifting heavy roller shades.

a. Provide for shadebands that weigh more than [**10 lb**] <**Insert value**> or for shades as recommended by manufacturer, whichever criterion is more stringent.

C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Roller Drive-End Location: Right side of interior face of shade.
2. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
3. Shadeband-to-Roller Attachment: Manufacturer's standard method.

D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

E. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.

F. Shadebands:

1. Shadeband Material: Light-filtering fabric.
2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

a. Type: Enclosed in sealed pocket of shadeband material.
b. Color and Finish: As selected by Design Professional from manufacturer's full range.

G. Installation Accessories:

1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.

a. Shape: L-shaped.
b. Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 4 inches.

2. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.

a. Height: Manufacturer's standard height required to enclose roller and shadeband assembly when shade is fully open, but not less than 4 inches.

2.3 MOTOR-OPERATED, SINGLE-ROLLER SHADES

A. Subject to compliance with requirements, provide products from one of the following manufacturers:

1. Draper, Inc.
2. MechoShade Systems, LLC
3. Springs Window Fashions

B. Motorized Operating System: Provide factory-assembled, shade-operator system of size and capacity and with features, characteristics, and accessories suitable for conditions indicated, complete with electric motor and factory-prewired motor controls, power disconnect switch, enclosures protecting controls and operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.

1. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Electric Motor: Manufacturer's standard tubular, enclosed in roller.

    a. Electrical Characteristics: 110-V ac.
    b. Maximum Total Shade Width: As required to operate roller shades indicated.
    c. Maximum Shade Drop: As required to operate roller shades indicated.
    d. Maximum Weight Capacity: As required to operate roller shades indicated.

3. Remote Control: Electric controls with NEMA ICS 6, Type 1 enclosure for surface mounting. Provide the following for remote-control activation of shades:

    a. Keyed Control Station: Keyed, maintained -contact, three-position, switch-operated control station with open, close, and off functions. Provide two keys per station. Group control each elevation within room.
    b. Color: As selected by Design Professional from manufacturer's full range.

4. Limit Switches: Adjustable switches interlocked with motor controls and set to stop shades automatically at fully raised and fully lowered positions.

C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Roller Drive-End Location: Right side of interior face of shade.
2. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
3. Shadeband-to-Roller Attachment: Manufacturer's standard method.

D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

E. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers that are operated by one roller drive-end assembly.

F. Shadebands:

1. Shadeband Material: Light-filtering fabric.
2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

a. Type: Enclosed in sealed pocket of shadeband material.
b. Color and Finish: As selected by Design Professional from manufacturer's full range.

G. Installation Accessories:

1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.

a. Shape: L-shaped.
b. Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 4 inches.

2. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.

a. Height: Manufacturer's standard in height required to enclose roller and shadeband assembly when shade is fully open, but not less than 4 inches.

2.4 SHADEBAND MATERIALS

A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.

1. Source: Roller shade manufacturer.
2. Type: Woven PVC-coated fiberglass and PVC-coated polyester.
3. Openness Factor: 5 percent.
4. Color: As selected by Design Professional from manufacturer's full range.

2.5 ROLLER SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.

C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:

1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.

PART 3 - EXECUTION

3.1 EXAMINATION

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

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

3.2 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

1. Opaque Shadebands: Located so shadeband is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

B. Electrical Connections: Connect motor-operated roller shades to building electrical system.

C. Roller Shade Locations: As indicated on Drawings.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Material Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Design Professional, before time of Material Completion.

3.5 DEMONSTRATION

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

END OF SECTION 12 24 13

SECTION 12 36 61.16 - SOLID SURFACING COUNTERTOPS

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. Solid surface material countertops.
2. Solid surface material backsplashes.
3. Solid surface material end splashes.

1.3 ACTION SUBMITTALS

A. Product Data: For countertop materials and sinks.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

1. Show locations and details of joints.
2. Show direction of directional pattern, if any.

C. Samples for Initial Selection: For each type of material exposed to view.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of countertops.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements before countertop fabrication is complete.

PART 2 - PRODUCTS

2.1 SOLID SURFACE COUNTERTOP MATERIALS

A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.

1. Manufacturers: Subject to compliance with requirements, provide products indicated on Finish Legend or comparable products by one of the following:

a. Caesarstone
b. Corian; a DuPont brand
c. Cosentino USA (Silestone)
d. Vicastone
e. Wilsonart

2. Type: Provide Standard type unless Special Purpose type is indicated.
3. Integral Sink Bowls: Comply with CSA B45.5/IAPMO Z124.

B. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 COUNTERTOP FABRICATION

A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Grade: Custom.

B. Configuration:

1. Front: Straight, slightly eased at top.
2. Backsplash: Straight, slightly eased at corner.
3. End Splash: Matching backsplash.

C. Countertops: 3/4-inch- thick, solid surface material with front edge built up with same material.

D. Backsplashes: 1/2-inch- thick, solid surface material.

E. Fabricate tops with shop-applied edges and backsplashes unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

1. Install integral sink bowls in countertops in the shop.

F. Joints: Fabricate countertops without joints.

G. Cutouts and Holes:

1. Undercounter Plumbing Fixtures: Make cutouts for fixtures using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
2. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.3 INSTALLATION MATERIALS

A. Adhesive: Product recommended by solid surface material manufacturer.

B. Sealant for Countertops: Comply with applicable requirements in Section 07 92 00 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.

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

3.2 INSTALLATION

A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.

B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

C. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

D. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.

1. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.

E. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.

F. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.

G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

1. Seal edges of cutouts in particleboard subtops by saturating with varnish.

H. Apply sealant to gaps at walls; comply with Section 07 92 00 "Joint Sealants."

END OF SECTION 12 36 61.16

SECTION 13 12 50 – HEAVY DUTY ALL ALUMINUM BLEACHER

PART 1 – GENERAL INFORMATION

1.1 SCOPE OF WORK

A. Furnish elevated bleachers equivalent to the Alum-A-Stand as manufactured by Dant Clayton Corporation, Louisville, KY (Basis-of-Design).

1.2 SUBMITTALS

A. Submit the following samples:

1. Seatboard
2. Footboard
3. Riserboard

B. Seating plan indicating aisles, seating sections.

C. End elevation indicating riser and row depth, deck configuration, railings, size of framing members.

D. Delegated-Design Submittal:

1. Include analysis data indicating compliance with performance requirements and design data signed and sealed by the qualified professional engineer responsible for their preparation. Professional Engineer shall be licensed in the State of Georgia. Submittal shall indicate all the design parameters indicated in 1.05.B in addition to the following parameters:
   a. Wind Design Data:
      1) Component & Cladding wind pressures.
   b. Earthquake Design Data:
      1) Basic seismic force-resisting system(s).
      2) Design base shear(s).
      3) Seismic response coefficient(s), Cs.
      4) Response modification coefficient(s), R.
      5) Analysis procedure used.

1.3 DESIGN CRITERIA

A. All material and workmanship shall be in accordance with the following:
AISC Manual, 14th Edition.
ACI 318-14 Building Code for Reinforced Concrete.
Aluminum Association of America.
2017 ICC 300 Standard for Bleachers, Folding and Telescoping Seating, and Grandstands.
2009 ICC A117.1 Accessible and Usable Buildings and Facilities.

ICC A117.1-09.
2018 IBC with Georgia State Amendments
Federal Handicap Legislation (ADA)
ASTM E985, standard specification for permanent metal railing systems and rails for buildings.

Design Loads:

Dead Load	6 psf	seat and footboards risers, etc.
Live Load	120 psf	to structural member
	120 plf	seatboards
	120 plf	footboards (individually)
Design Wind Speed	120 mph	on projected vertical surface
Sway	24 plf	parallel per ft. of seat parallel to seat run
	10 plf	perpendicular per foot of seat
Guardrail Loads	50 plf	distributed or 200 lb concentrated load applied in any direction
Treads:	300 lbs	concentrated load on an area of 4 square inches.

Guards, infill components: a horizontal force of 50 lbs on an area equal to 1 square foot.

B. Understructure Criteria:

1. The following criteria is used to establish a minimum requirement for strength, stiffness, and rigidity of the understructure components.

Moment of inertia of	.822
Section modulas of	.576
Radius of gyration of	.975
Axial loading of	.889

C. Code Compliance: Submittals shall be based on specifications contained in the bid documents or the latest code edition adopted at the time of bidding.

1.4 QUALITY ASSURANCE

A. Manufacturer: Company specializing in spectator seating with a minimum of 10 years experience in manufacturing bleacher seating.

B. Engineer Qualifications: The bleacher shall be designed under the supervision of a professional engineer registered in the state of Georgia.

C. Warranty: Product shall be guaranteed for five (5) years on the structure and three (3) years on the finish together with labor. Damage resulting from abnormal use, vandalism, or incorrect installation (if done by other than authorized installer of the manufacturer) is not applicable. Any exposed mill finish aluminum surface will become discolored due to oxidation which is a natural phenomenon.

PART 2 – PRODUCTS

2.1 BASIS OF DESIGN MANUFACTURER

The basis of design manufacturer for seating is Dant Clayton Corporation, 1500 Bernheim Lane, Louisville, KY 40210, 800-626-2177.

2.2 MATERIALS

A. Understructure:

1. Understructure shall be fabricated from 6061-T6 alloy aluminum extrusions.
2. Vertical members shall be 2 7/8" o.d. tubing or minimum L3.5x3.5x1/4 angles.
3. Horizontal members and footboard supports shall be 3" x 2 7/8" channel or minimum L2.5xL2.5x3/16 angles.
4. Cross braces and diagonals shall be 2 ¼" x 7/8" channel or 2"x2" angle.
5. Handrail support shall be 2 5/8" o.d. tubing.
6. The understructure shall be assembled from the above items in an interlocking design and 7/16" x 3 ½" hot-dipped galvanized bolts.
7. The structure shall be designed so that in the event of accidental damage, the sub-component parts may be replaced using common hand tools. Field welding for repair purposes shall not be considered.
8. Primary structural members shall be bolted together, or calculations must be submitted verifying that the structure has taken into account the weakening of aluminum associated with welding per 2005 AA ADMI sections 7.2.1 and 7.2.3.

B. Guardrail Systems:

1. Guardrails shall be of anodized aluminum extruded channel, 3 x 2 7/8", 6061-T6 alloy, anodized to clear 204R1.
2. The guardrail system shall be of interlocking design with positive through bolt fastening. The top rail shall be designed to fully cover the rail support posts for a totally snag-free area and eliminate the potential of sharp edge contact with the spectators.
3. Grabrails shall be extruded aluminum pipe of 6063-T6 alloy, 1 – 15/16" o.d.
4. Chain link fence shall be 2" mesh, 6 gauge vinyl coated fabric.

C. Hand & Grab Rails

1. Hand and Grab Rails shall be located in all areas required by building code.
2. Hand and Grab Rails shall be 1 15/16" O.D. extruded aluminum pipe.
3. Two-Line mid-aisle handrails shall be located in all interior aisles. All mid-aisle rails shall feature internal fittings for both lines of rail. External fittings are not permitted.

D. Extrusions

1. Seats shall be 6063-T6 extruded aluminum with a fluted surface and a wall thickness of .078". Seatboards shall be a minimum of 9½" wide actual, with outside legs of 1 ¾" actual vertical height and shall have two internal legs with a vertical height of 2 5/8".

Seatboards shall attach with one 3/8" diameter bolt and shall be designed for positive physical fastening. Bolt clips, bolt runners or other friction type fastening devices are not acceptable. Seats shall be pre-treated and clear anodized.

2. Footboards shall be 6063-T6 extruded aluminum with a fluted surface and a wall thickness of .078". Each footboard member (individually) shall have two internal legs with 2 1/8" actual vertical height. All footboards shall attach without the use of hardware. Attachment shall be positive snap and interlock with the support structure. Use of bolt clips, bolt runners, or other friction type fastening devices are not acceptable.
3. Riserboards shall be 6063-T6 extruded aluminum and shall be pre-treated and clear anodized.
4. WALKING SURFACE REQUIREMENT - All aluminum footboards shall have an enhanced stain resistant and slip resistant 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 and shall be uniform in appearance. The slip and stain resistant surface treatment must be achieved with a blasted and anodized process. The metallic media blasting option must be performed in a controlled factory environment to ensure consistency. Hand processes or sand blasting is strictly prohibited as they produce an inconsistent finish that is not uniform in appearance or performance.
    b. This surface finish shall prevent oxidation staining and be resistant to staining from beverage spills and organic matter. Oxidation staining prior to warranty expiration 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.

E. Stairs:

1. Shall conform to all above pertinent criteria consistent with the component design of the grandstand.
2. Shall be self-supporting and shall not attach to or be suspended from any footboard of decking member.

F. Aisles:

1. Aisles shall be designed so that all vertical and horizontal areas within the 6' bay of the aisles area shall be fully closed.

G. Ramps and Ramp Platforms:

1. Frames shall be 9" x 1.40 extruded aluminum mill finish channel with 3" x 1.4" extruded aluminum mill finish vertical channel columns.
2. Treads shall be 6063-T6 extruded aluminum with a fluted surface and a minimum wall thickness of .078". Minimum vertical height of treads shall be 1.75" actual. Treads shall be mill finish.

H. Hardware:

1. Bolts used for field installation shall be hot dipped galvanized.
2. Primary connections, i.e. seat, crossbrace, handrail (rail and posts) shall be made with minimum of 3/8" diameter hardware.
3. End Caps – All end caps (seatboard, footboard and handrail) shall be cast aluminum.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Installation: Shall be handled directly by the manufacturer or by a factory certified installation subcontractor.

B. Erect per plans, shop drawings and specifications.

3.2 CLEANING

A. Clean all surfaces according to manufacturer's recommendations.

B. Remove all packaging and construction debris.

END OF SECTION 13 12 50

SECTION 13 34 16.13 – PERMANENT GRANDSTAND SEATING SYSTEM

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Provide engineering, material, freight, installation and supervision to provide a new permanent grandstand structure in accordance with the following specifications.

B. Minimum acceptable criteria:

1. Design per plan view and sectional view drawings
2. Galvanized and Powder coated structural steel understructure (TBD) per 2.02.1.H.2 and 3
3. Structural steel sizing as shown and spacing on drawings per Part 4 Peer Review
4. Continuous aluminum welded decking system with Slip and Stain Resistant (SSRD) surface.
5. 16/32 rise/run bleacher section with riser mounted seatboard brackets, which must have a structural steel connection
6. Powder coated riser boards (school colors) with 100% coverage front and back
7. All concrete foundations for structural columns as sized and shown on drawings and all concrete pads for ramps and stairs per Part 4 Peer Review.
8. Any relevant Qualification Evaluation Form and/or Technical Bid Proposal Form

1.2 RELATED WORK/RELATED SECTION

Concrete - Division 03
Earth Work - Division 31
Exterior Improvements - Division 32
Pressbox - Section 13 34 16.63

1.3 SITE VISITATION

A. Visitation to the site seven (7) days prior to bid date by a qualified representative of the grandstand manufacturer is mandatory. No allowance will be made after the contract award for any problems encountered which would have been discovered during the pre-bid visitation.

1.4 DESIGN CRITERIA

A. All material and workmanship shall be in accordance with the following:

1. 2018 IBC with Georgia State Amendments
2. Georgia State Electrical Code NFPA 70-17
3. Georgia State Mechanical Code 2018 IMC
4. Georgia State Plumbing Code 2018 IPC
5. Grandstand Code ICC 300-17
6. Accessible and Usable Buildings and Facilities ICC A117.1 – 2009

7. NFPA-101 and NFPA-102 Current Edition
8. AISC Manual of Steel Construction, Load & Resistance factor Design, 2nd Edition
9. ACI Building Code for Reinforced Concrete
10. Aluminum Association of America
11. ASTM E985, standard specification for permanent metal railing systems and rails for buildings.
12. ADA, Americans with Disabilities Act accessibility guidelines.
13. AWS D1.2, American Welding Society

B. Design Loads:

Dead Load	6 psf	seat and footboards, risers, steel framing, etc.
Live Load	100 psf	to structural members. All stringers and girders shall be limited to L/200 for maximum vertical live load deflection.
	120 plf	Seatboards
	120 plf	Footboards
Design Wind Speed (local conditions)	146 mph	On projected vertical surface
Sway	24 plf	Per lineal foot of seat, parallel to seat run
Sway	10 plf	Per lineal foot of seat, perpendicular to seat

C. Deflection: Structural elements shall be sized to limit the live load deflections to 1/200 of the span. Calculation shall be submitted with shop details confirming 1/200 deflection criteria.

D. Foundations: Foundations have been sized by an engineer and are based on soil bearing capacity of 2,500 psf (TBD). Soil bearing capacity to be verified by the Owner prior to placement of footings. Foundation sizes on drawings will not be reduced under any circumstance. Downsizing or redesigned foundations are not allowed.

1.5 SITE REPRESENTATION

A qualified representative of the grandstand manufacturer must be onsite at all times during installation of the grandstand.

1.6 QUALITY ASSURANCE

A. Fabricator to comply with applicable provisions of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
B. All structural steel is to be fabricated by a company that participates in the AISC Certification Program and holds a current STD certificate at time of bid. (STD – Standard for Steel Building Structures)
C. Manufacturer shall have a minimum of five (5) years' experience in fabrication of grandstand structures.

1.7 SUBMITTALS

A. Fabricator AISC Certificate of compliance with the Standard for Steel Building Structures

B. Product Certificate: Prepare written statement on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

C. At least 4 weeks prior to submittal of rebar shop drawings for the bleacher foundations. Submit final reactions for the bleachers to be applied to the foundations for Engineer of Record to review. Reactions shall be broken down by load case and shall clearly indicate if the reaction is allowable or ultimate level.

D. Shop Drawings: Complete detailed drawings prepared, signed and sealed by a Registered Professional Engineer (P.E.) licensed in the State of Georgia. 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 State of Georgia.

3. Sections and details showing complete methods of assembly and anchorage.

4. Engineering calculations. Engineering calculations shall clearly show all load cases, load combinations for each member as well as allowable stresses. Calculations shall include design of all members including, but not limited to, anchor bolts, columns, seats, guardrails, stairs, beams, braces and all connections. Engineering calculations shall be sealed by a Registered Professional Engineer (P.E.) licensed in the State of Georgia.

E. Qualifications of Professional Engineer who seals the shop drawings and calculations.

F. Independent test data confirming the coefficient of friction and durability of the slip resistant finish.

1.8 WARRANTY

Product shall be guaranteed for five (5) years on the structure and three (3) years on the finishes together with labor. Damage resulting from abnormal use, vandalism, or incorrect installation (if done by other than authorized installer of the manufacturer) is not applicable. It is understood that any exposed mill finish aluminum surface will become mildly discolored due to oxidation which is a natural phenomenon; the manufacturer will not be held responsible or liable for oxidation of mill finish aluminum.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. The basis of design is Southern Bleacher Company, PO Box One, Graham, Texas 76450. Other manufacturers requesting to bid shall conform to all the specifications and design documents. Acceptable manufacturers have full responsibility to meet these specifications.

2.2 MATERIALS

A. Structural Steel

1. All detailing, fabrication, and erection shall be in accordance with AISC Specifications, Load & Resistance Factor Design, 2nd Edition
2. Structural steel shall be ASTM A572 multi-certified grade 50, Miscellaneous steel shall be ASTM A36.
3. All structural bolts are hot dipped galvanized and equal to or greater than A-307.
4. All welds shall be all around with type ER70S-6 wire mig.
5. Steel Finish
   a. Galvanized and Powder Coated Steel

      Structural steel shall be coated with a minimum of 2 oz. hot dipped galvanized in accordance with ASTM 123-A with a minimum galvanized film thickness of 3.3 mils. Zinc shall be 98% purity, certified with written test results based on samples taken from the tank.

      1) All ferrous metal components shall be blast cleaned to an SSPC-6 commercial blast clean.
      2) Powder for coating shall be a polyester-based thermal setting resin.
      3) Powder coat system shall meet or exceed the following test requirements:
         a) Direct Impact Resistance: ASTM D 2794-93, up to 160 in.-lbs.
         b) Flexibility: ASTM D 522-93, Method B, equal to or less than a 1/4-inch mandrel.
         c) Pencil Hardness: ASTM D 3363-93a, HB-2H
         d) Crosshatch Adhesion: ASTM D 3359-97, Method B, 5B
         e) Salt Spray Resistance: ASTM B 117, plus 1,000 hours
         f) Humidity Resistance: ASTM D 2247, plus 1,000 hours.

   b. Final coat of finish for structural steel shall not be field applied.

B. Handrail

1. Anodized aluminum 1-1/4” nominal pipe size (1-5/8” OD)

C. Seating

1. Bench seatboards shall be 2” x 10” anodized aluminum. Aluminum shall be cleaned, pre-treated and clear anodized.
2. Mounting brackets: mill aluminum finish.
3. Seatboards shall be attached to the system by riser mounted aluminum “L” brackets (deck mounted brackets not allowed). The seatboards shall align with the intermediate steps at the aisles.

D. Decking System

1. Fully Closed Interlocking Deck
   a. Decking shall consist of painted aluminum interlocking deck treads with painted aluminum flat risers.
   b. The decking system will run from raker beam to raker beam. There will be a ½” gap at joint of the welded deck panels to allow for expansion and construction of

the aluminum due to temperature variations. No mid-span splices for decking is allowed.

c. Riser height per row and tread depth per row is indicated on design drawings.
d. The ends of decking system will be finished with a one-piece aluminum angle end cap.

E. Walking Surface Requirement

1. All aluminum decking intended for use as a walking surface, including walkways, aisles, walking surfaces in seating sections, stairs, ramps, platforms, handicap areas, and landings, will exhibit a slip and stain resistant surface treatment intended to minimize the effects of wet conditions on pedestrian safety.
2. This surface finish will increase the slip resistance of mill finished aluminum in all directions of travel, including parallel to seating.
3. Untreated 'mill finish' aluminum with raised extruded 'flutes' or 'ribs' does not meet this requirement.
4. A sample of the manufacturer's slip and stain resistant surface finish is required to be submitted for approval seven (7) days prior to bid for Owner/Architect's approval.

F. Ramps, Stairs, Ramp Platforms, Stair Platforms, and Guardrails

Shall conform to both the specifications herein and local building codes.

1. Ramps shall be configured as shown on drawings.
2. Ramps shall have a maximum slope of 1:12 and shall have the same guard railing as the rest of the grandstand.
3. Ramps shall have a minimum post spacing of 3 ft and a maximum post spacing of 9 ft.
4. Guardrails and material finishes shall match those on the grandstand.

G. Stairs

1. Minimum vertical leg spacing is 3 ft. Maximum spacing is 9 ft.
2. Guardrail on the stairs shall match the guardrail on the stand.
3. Material finishes shall match those on the grandstand.

H. Hand & Grab Rails

1. Hand and Grab Rails shall be in all areas required by building code.
2. Hand and Grab Rails shall be 1-5/8" O.D. anodized aluminum pipe.
3. Two-Line mid-aisle handrails shall be in all interior aisles. All mid-aisle rails shall feature internal fittings for both lines of rail. External fittings are not permitted.

I. Guardrails

1. Structural Performance of Handrails and Railings: Provide handrails and railings capable of withstanding the following structural loads without exceeding allowable design working stresses of materials for handrails, railings, anchors, and connections:

a. Top Rail of Guards: Capable of withstanding the following loads applied as indicated:
   1) Concentrated load of 200 lbf. (730 N/m) applied at any point and in any direction.
   2) Uniform load of 50 lbf/ft. (730 N/m) applied horizontally and concurrently with uniform load of 100 lbf/ft. (1460 N/m) applied vertically downward.
   3) Concentrated and uniform loads above need not be assumed to act concurrently.

b. Handrails Not Serving as Top Rails: Capable of withstanding the following loads applied as indicated:
   1) Concentrated load of 200 lbf/ft. (890 N/m) applied in any direction.
   2) Uniform load of 50 lbf/ft. (730 N/m) applied in any direction.
   3) Concentrated and uniform loads above need not be assumed to act concurrently.

c. Infill Area of Guards: Capable of withstanding a horizontal concentrated load of 200 lbf (890N) applied to 1 sq. ft. (0.09 sq. m) at any point in system, including panels, intermediate rails, balusters, or other elements composing infill area.
   1) Load above need not be assumed to act concurrently with loads on top rails in determining stress on guard.

2. Thermal Movements: Provide handrails and railings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   a. Temperature Change (Range): 120 deg F (67 deg C), ambient 180 deg F (100 deg C), Material surfaces.

3. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incomparable materials.

J. Submittals

1. Shop Drawings: Show fabrication and installation of mechanically connected handrails and guardrails. Include plans, elevations, sections, component details, and attachments to other Work.
   a. For installed handrails and railings indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

2. Qualification Date: For firms and persons specified in “Quality Assurance” Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

K. Quality Assurance

1. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in Georgia and who is experienced in providing engineering service of the kind indicated. Engineering services are defined as those performed for installations of

handrails and railings that are similar to those indicated for this Project in material, design, and extent.

a. Source Limitations: Obtain each type of handrail and railing through one source from a single Manufacturer.

PART 2 – VERTICAL PICKET RAILS

2.1 METALS

A. General: Provide metal free from pitting, seam marks, roller marks, stains, discolorations, and other imperfections where exposed to view on finished units.

B. Vertical balusters shall be of ½" square ASTM A36 bar stock

C. Top and Bottom Horizontal Rails shall be fabricated from 1 ½" x 11-gauge ASTM A36 square tubing.

D. Posts shall be fabricated from 2" x 2" x 3/16" ASTM A36 square tubing.

E. Grab rails shall be from 1 ½" (1.9" O.D.) anodized aluminum pipe of 6061-T6 alloy. Mechanical fittings will be used with internal splices for connections.

2.2 FABRICATION

A. General: Fabricate handrails and railing to comply with requirements indicated for design, dimensions, member size, and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Assembly shall be in a neat and craftsman like manner in accordance with the highest industry standards.

1. Vertical balusters must be spaced in 4" centers
2. Vertical balusters shall be shop welded to the top and bottom horizontal members.
3. Weld to be smooth seam welds sealing around all the joints in materials.

C. Welding Connections: All welds should be performed prior to finish being applied. Fabricate handrails and railings for connecting members by welding. Weld connections continuously to comply with the following:

1. Use the materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.

2.3 FINISHES, GENERAL

A. Steel finish will be painted. Color to be chosen from manufacturers standard color specification.

B. Aluminum handrail finish will be anodized extruded aluminum pipe.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with shop drawings and manufacturer's instructions.

B. Erect work square and level, horizontal and parallel to rake of steps and ramps, and free from distortion or defects detrimental to appearance or performance.

C. No field welded connections will be acceptable

3.2 ANCHORING POSTS

A. Unless indicated for anchoring into concrete with metal base plates with expansion anchors. Form or core-drill holes not less than 5 inches (125mm) deep and ¾ inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with non-shrink, non-metallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions:

B. Leave anchorage joint exposed; wipe off surplus anchoring material.

3.3 PROTECTION

A. Protect finishes of handrails and railings from damage during construction period.

1. Restore finishes damaged during installation and construction period so no evidence remains correction work. Return items that cannot be refinished in the field; make required alterations and refinish entire unit or provide new units.

3.4 END CAPS

A. Walkways, footboards, and aisle board end caps shall be one-piece mill finish aluminum angle design, tumbled after fabrication to remove burrs and sharp edges. End caps shall be riveted to the planks.

B. Seatboard end caps shall be one-piece cast aluminum and shall be friction-fit to the plank without the use of mechanical fasteners.

C. Guardrail posts shall be covered with cast aluminum top caps.

3.5 HANDICAP AREAS

A. Handicap areas will be per design drawings

3.6 VERTICAL CLOSURE SYSTEMS

A. Vertical closure shall be provided at the following locations and shall enclose the area from the grandstand or associated accessory walking surface to 4" above grade:

1. Front of platforms flanking the pressbox
2. Egress ramps, stairs and associated platforms
3. Handicap seating recesses at front horizontal aisle

B. Vertical closure material shall be extruded aluminum riserboards 6" in height that interlock with a variable height top closure that has a finished top surface to dress the top edge of the closure

at the adjacent walking surface. Vertical closure shall be provided in a color powder coated (or anodized) finish.

C. Panels shall be provided in manufacturer's standard color

D. Panels shall have a maximum water absorption of 0.3%

3.7 REINFORCED CONCRETE

A. All concrete work and materials shall be in accordance with ACI 318 and specifications within Division 03.

B. Embedment of reinforcing in concrete shall be as follows, unless otherwise noted on drawings:

3" Placed directly against earth
2" Concrete poured against forms and exposed to weather
1 ½" Columns to ties

3.8 INSTALLATION

A. Installation shall be handled directly by the manufacturer or by a factory-certified installation subcontractor. Factory certification shall require three installations within the last two years within the state.

B. Structure shall be erected in accordance with plans, shop drawings, and specifications.

C. Site preparation is not included in this specification.

3.9 CLEANING

B. Clean all surfaces after erection, in accordance with manufacturer's recommendations.

C. Remove and properly dispose of all packaging and construction debris.

D. Do not use acid solution, steel wool or other harsh abrasives.

PART 4 - STRUCTURAL PEER REVIEW GUIDLINES

4.1 LOADING

A. Based on LRFD design verify the following load combinations were considered in the analysis of the steel structure:

1.2(dead) + 1.6(live)
1.2(dead) + 1.6(snow) + 1.0(live)
1.2(dead) + 1.3(wind) + 1.0(live) + 0.5(snow)
1.2(dead) + 1.3(sway) + 1.0(live)
1.2(dead) ± 1.0(seismic) + 1.0(live) + 0.2(snow)
0.9(dead) ± 1.3(wind)

4.2 FOUNDATIONS

A. Verify the following load combinations were considered in the calculation of the soil bearing stress under the footing:
1.0(dead)+1.0(live)
1.0(dead)+1.0(live) ± 1.0(wind)
1.0(dead)+1.0(live) ± 1.0(sway)
1.0(dead)+1.0(live) ± 1.0(seismic)

B. Verify actual soil bearing stresses were calculated for combined vertical and lateral loads.

C. Verify the actual soil bearing stress does not exceed the allowable soil bearing stress stated in the geotechnical report or contract documents.

D. Verify the foundation design reflects the recommendations and conclusions given in the geotechnical report.

E. Verify foundations were checked for overturning. Foundations must be sized appropriately to assure no uplift (negative bearing pressures) occurs for the following load case:
1.0(dead)+1.0(wind)

F. Verify the foundations were designed to develop the necessary strength to resist all moments, shears, and other internal actions caused by the applied loads using ACI requirements.

G. Verify the anchor bolts were designed for yielding of the steel and pullout of the concrete.

4.3 STEEL DESIGN

A. Verify all support beams and stringers were checked for the following per AISC – LRFD 2nd ED:
1. Yielding
2. Biaxial Bending, full dead load + full live load + sway and wind loads
3. Lateral-Torsional Buckling
4. Crippling and Vertical Buckling of webs

B. Verify that the compression flange of steel beams is adequately braced to prevent lateral buckling.

C. Verify that the lateral bracing was designed to withstand the factored wind and sway loads.

D. Verify all columns were designed according to AISC – LRFD 2nd ED.

E. Verify all column base plates were designed according to AISC – LRFD 2nd ED.

F. Verify all connections were designed according to AISC – LRFD 2nd ED.

G. Verify the calculations show that no structural member has a deflection greater than L/200 under service live loads.

H. Verify members, in which the stresses or deflections are greater under a partial loading of the grandstand than under a full load, were designed for the controlling condition.

4.4 ALUMINUM DESIGN

A. Verify the footboards and seatboards were designed to support 120 lb/ft.

B. Verify guard rails and handrails were designed to support the worst case of the following loads:
1. A concentrated load of 200 lb applied at any point and in any direction along the top railing member.

OR

2. A uniform load of 50 lb/ft applied horizontally at the required guard rail height and a simultaneous uniform load of 100 lb/ft applied vertically downward at the top of the guardrail.

END OF SECTION 13 34 16.13

SECTION 13 34 16.63 – PRESS BOX

PART 1 – GENERAL

1.1 SCOPE of WORK

A. Furnish a prefabricated, modular press box for the stadium equal to that as provided by Southern Bleacher Company, Graham, Texas.

1.2 RELATED WORK/RELATED SECTION

A. Grandstand - Section 13 34 16.13

B. Electrical – Division 26

C. Communications – Division 27

D. Thermal and Moisture Protection – Division 07

E. Wood, Plastics and Composites – Division 06

1.3 SUBMITTALS

A. Bidders with any deviation from the specifications must comply with the following requirements seven (7) days prior to the bid opening.

1. Plan view and wall section showing complete detail of layout, connection and trim detail.
2. Schedule of Work Experience, including names of contacts and phone numbers; 10 jobs minimum within the last five (5) years.
3. List of three (3) similar jobs within the past two (2) years – should owners (3 persons maximum) request a site visitation to these jobs, it will be at the bidder's expense.
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. Shop drawings stamped and signed by a Professional Engineer licensed in the state of Georgia.

1.4 DESIGN CRITERIA

A. All material and workmanship shall be in accordance with the following:

2018 IBC with Georgia State Amendments
Georgia State Electrical Code NFPA 70-17
Georgia State Mechanical Code 2018 IMC
Accessible and Usable Buildings and Facilities ICC A117.1 – 2009
NFPA-101 Current Edition
ADA, Americans with Disabilities Act accessibility guidelines.

B. All electric components shall be UL listed.

C. Design Loads:

1.	Live Load	100 psf Floor
		50 psf Roof (w/ filming platform)
	Wind	20 psf on vertical surfaces

D. Design Classification

1. Use Group: A-5, Construction Type: V-B

1.5 QUALITY ASSURANCE

A. Manufacturer: Company specializing in modular building construction with a minimum of five (5) years' experience in manufacturing press boxes.

B. Engineer qualifications: The press box shall be approved by a registered professional engineer in the state of Georgia.

C. Warranty: Press box shall be guaranteed for three (3) years against defective material or workmanship. Damage resulting from abnormal use or vandalism is not applicable.

PART 2 – PRODUCTS

2.1 FLOOR CONSTRUCTION

A. Bottom Board: .029 GA. one-piece galvanized steel bottom pan.

B. Sheathing: ½" CDX Dricon Fire-retardant plywood sheathing.

C. Insulation: 3.5" R15 insulation

D. Joists: W10X12

E. Decking: "Interlock" aluminum deck system

F. Molding: 4" resilient vinyl base.

2.2 WALL CONSTRUCTION

A. Studs: 4" x 4" x 11 GA. square tubing

B. Headers: According to span.

C. Ceiling Height: 8'-0" to ACT suspended ceiling.

D. Wall covering: 1/2" vinyl-faced gypsum panels.

E. Insulation: 4" R-15 fiberglass batts with vapor barrier.

F. Siding: To be clad on site by general contractor per design documents.

G. Provide blocking at west wall at stadium press box for pin mounted field-applied graphics.

2.3 ROOF CONSTRUCTION

A. Joists: (Welded Framing) 80 CSJ16, 8" x 16ga. Welded galvanized steel joists, 16" O.C. spacing. Flat assembly without overhangs to receive built-up roof and cornice assembly.

B. Ceiling at stadium press box to be exposed t-grid acoustical suspended ceiling system with US Gypsum 2' x 2' humidity-resistant tile.

C. Overhang: Stadium press box; no overhang.
D. Insulation: 6" R-19 fiberglass batts with vapor barrier.

E. Decking: 3/4" Sturdifloor, underlayment grade, Dricon fire retardant treated, tongue & groove-oriented strand board. (Index 24" O.C.)

F. Covering: .060 single-ply EPDM rubber membrane, fully adhered for protection during transport to site. Finished sloped roof at stadium press box will be constructed on site by general contractor per design documents.

2.4 WINDOWS

A. Wintech "6000 series" double horizontal slider window w/ extruded aluminum frames, AAMA LC-25 structural rating, w/ ¾" insulated low-E, argon filled tempered glass and removable insect screens at the stadium press box. Wintech "6000 series" single-hung vertical slider window w/ extruded aluminum frames, AAMA LC-25 structural rating, w/ ¾" insulated low-E, argon filled tempered glass and removable insect screens at the baseball and softball press boxes. Frame color to be manufactures standard matching field applied aluminum cladding panels or trim.

B. Interior Windows to be ¼" tempered safety glass fixed pan with stained jambs and casing

2.5 DOORS

A. 18GA. Insulated hollow metal door with 16GA. Steel wrap around frames, vinyl weather-stripping, aluminum threshold and lever handled lock sets per school standards.

B. Doors (Interior) - 1-3/8" Solid-core stained birch with stained birch wood jambs and casing and passage lever handled hardware per school standards.

2.6 INTERIOR PARTITIONS

A. Full depth interior partition; insulated for sound attenuation. Door specified in 2.5.

2.7 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. Low voltage pull boxes for Owner's PA, scoring, data, etc.

C. Lighting: 2'x2' and 4'x4' surface mounted LED fixtures, wall mounted LED utility strip fixture.

D. Circuits: All branch circuit wiring is minimum #12 THHN encased in EMT thin wall conduit.

2.8 HVAC

A. Stadium press box: Multi-zone heat pump: (5) zone mini-split heating/cooling system, (5) one-way ceiling cassettes recessed in suspended ceiling assembly. Coordinate size/BTU requirements with GC for on-site installation by licensed contractor. Condensing unit(s) to be grouped below press box at grade, behind (east) official's building.

2.9 SCORERS' COUNTER

A. 18" deep anodized aluminum countertop

PART 3 – EXECUTION

3.1 INSTALLATION

A. Installation: Shall be handled directly by the manufacturer or by a factory certified installation subcontractor.

B. Erect per plans, shop drawings, and specifications.

3.2 CLEANING

A. Clean all surfaces according to manufacturer's recommendations.

B. Remove all packaging and construction debris.

3.3 GC RESPONSIBILITY

A. Site access

B. Final electrical and communications hook-up

C. Field applied custom wall panels, cornice and hipped roof

END OF SECTION 13 34 16.63

SECTION 14 21 23.16 - MACHINE ROOM-LESS ELECTRIC TRACTION PASSENGER ELEVATORS

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. Machine-room-less electric traction passenger elevators.

B. Related Requirements:

1. Section 01 50 00 "Temporary Facilities and Controls" for temporary use of elevators for construction purposes.
2. Section 03 30 00 "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
3. Section 04 20 00 "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry and for grouting elevator entrance frames installed in masonry walls.
4. Section 05 12 00 "Structural Steel Framing" for the following:

    a. Attachment plates, angle brackets, and other preparation of structural steel for fastening guide-rail brackets.
    b. Hoist beams.
    c. Structural-steel shapes for subsills.

5. Section 05 50 00 "Metal Fabrications" for the following:

    a. Pit ladders.

6. Section 22 14 29 "Sump Pumps" for sump pumps, sumps, and sump covers in elevator pits.
7. Section 27 01 10 "Intelligent Fire Alarm System" for smoke detectors in elevator lobbies to initiate emergency recall operation, for heat detectors in shafts and machine rooms to disconnect power from elevator equipment before or on sprinkler activation, and for connection to elevator controllers.

1.3 DEFINITIONS

A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.

B. Service Elevator: A passenger elevator that is also used to carry freight.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include capacities, sizes, performances, operations, safety features, finishes, and similar information.
2. Include Product Data for car enclosures, hoistway entrances, and operation, control, and signal systems.

B. Shop Drawings:

1. Include plans, elevations, sections, and large-scale details indicating service at each landing, coordination with building structure, relationships with other construction, and locations of equipment.
2. Include large-scale layout of car-control station.
3. Indicate maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway and pit layout and dimensions, as indicated on Drawings, and electrical service, as shown and specified, are adequate for elevator system being provided.

C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

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

1. Submit manufacturer's or Installer's standard operation and maintenance manual, according to ASME A17.1/CSA B44 including diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.

B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

C. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard two-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Elevator manufacturer or an authorized representative who is trained and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.9 COORDINATION

A. Coordinate installation of inserts, sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, inserts, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.

B. Coordinate locations and dimensions of work specified in other Sections that relates to electric traction elevators including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways and pits.

1.10 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
2. Warranty Period: 2 year(s) from date of Final Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Otis Elevator Company
2. Schindler Elevator Corporation (basis-of-design)
3. Thyssenkrupp Elevator

B. Source Limitations: Obtain elevators from single manufacturer.

1. Major elevator components, including driving machines, controllers, signal fixtures, door operators, car frames, cars, and entrances, shall be manufactured by single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.

B. Accessibility Requirements: Comply with requirements for accessible elevators in the United States Access Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.

2.3 ELEVATORS

A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturer's standard components shall be used, as included in standard elevator systems and as required for complete system.

B. Elevator Description:

1. Elevator Number(s): ELEV 1302, ELEV 1860.
2. Rated Load: 3500 lb.
3. Freight Loading Class for Service Elevator(s): Class A.
4. Rated Speed: 100 fpm.
5. Auxiliary Operations:

    a. Standby power operation.
    b. Standby-powered lowering.
    c. Battery-powered automatic evacuation.
    d. Automatic dispatching of loaded car.
    e. Nuisance-call cancel.

6. Car Enclosures:

    a. Inside Height: Not less than 93 inches to underside of ceiling.
    b. Front Walls (Return Panels): Satin stainless steel, ASTM A480/480M, No. 4 finish.
    c. Car Fixtures: Satin stainless steel, ASTM A480/480M, No. 4 finish.
    d. Side and Rear Wall Panels: Plastic laminate.
    e. Reveals: Enameled or powder-coated steel.
    f. Door Faces (Interior): Satin stainless steel, ASTM A480/480M, No. 4 finish.
    g. Door Sills: Aluminum.
    h. Ceiling: Luminous ceiling – LED lighting.
    i. Handrails: 1/2 by 2 inches rectangular, at sides of car.
    j. Floor prepared to receive resilient flooring (specified in Finish Schedule).

7. Hoistway Entrances:

a. Width: 42 inches.
b. Height: 84 inches.
c. Type: Single-speed side sliding.
d. Frames: Satin stainless steel, ASTM A480/480M, No. 4 finish.
e. Enameled or powder-coated steelDoors: Satin stainless steel, ASTM A480/480M, No. 4 finish.
f. Sills: Aluminum.

8. Hall Fixtures: Satin stainless steel, ASTM A480/480M, No. 4 finish.
9. Additional Requirements:

a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, ASTM A480/480M, No. 4 finish.
b. Provide hooks for protective pads in all cars and one complete set(s) of full-height protective pads.

2.4 TRACTION SYSTEMS

A. Elevator Machines: Permanent magnet, variable-voltage, variable-frequency, ac-type hoisting machines and solid-state power converters.

1. Provide regenerative system.
2. Limit total harmonic distortion of regenerated power to 5 percent per IEEE 519.
3. Provide means for absorbing regenerated power when elevator system is operating on standby power.
4. Provide line filters or chokes to prevent electrical peaks or spikes from feeding back into building power system.
5. Provide means for absorbing regenerated power when elevator system is operating on standby power.

B. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.

C. Machine Beams: Provide steel framing to support elevator hoisting machine and deflector sheaves from the building structure. Comply with Section 05 50 00 "Metal Fabrications" for materials and fabrication.

D. Car Frame and Platform: Welded-steel units.

E. Guides: Roller guides or polymer-coated, nonlubricated sliding guides. Provide guides at top and bottom of car and counterweight frames.

2.5 OPERATION SYSTEMS

A. Provide manufacturer's standard microprocessor operation systems as required to provide type of operation indicated.

B. Auxiliary Operations:

1. Single-Car Standby-Powered Lowering: On activation of standby power, if car is at a floor, it remains at that floor, opens its doors, and shuts down. If car is between floors, it is lowered to the next floor below, opens its doors, and shuts down.
2. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors begin closing.
3. Nuisance-Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of calls and predetermined weight can be adjusted.
4. Loaded-Car Bypass: When car load exceeds 80 percent of rated capacity, car responds only to car calls, not to hall calls.

C. Security features shall not affect emergency firefighters' service.

1. Card-Reader Operation: System uses card readers at car-control stations to authorize calls. Security system determines which landings and at what times calls require authorization by card reader. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers..

a. Security access system equipment is provided by the Owner.

2.6 DOOR REOPENING DEVICES

A. Infrared Array: Provide door reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams shall cause doors to stop and reopen.

B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.

2.7 CAR ENCLOSURES

A. Provide steel-framed car enclosures with nonremovable wall panels, with removable car roof, access doors, power door operators, and ventilation.

1. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.

B. Materials and Finishes: Manufacturer's standards, but not less than the following:

1. Subfloor:

a. Exterior, C-C Plugged grade plywood, not less than 7/8-inch nominal thickness.

2. Floor Finish:

a. Specified in Finish Schedule on drawings.
b. Elevator manufacturer's standard level-loop nylon carpet; color as selected by Architect from full range of industry colors.

3. Stainless Steel Wall Panels: Flush, formed-metal construction; fabricated from stainless steel sheet.
4. Fabricate car with recesses and cutouts for signal equipment.
5. Fabricate car door frame integrally with front wall of car.
6. Stainless Steel Doors: Flush, hollow-metal construction; fabricated from stainless steel sheet.
7. Sight Guards: Provide sight guards on car doors.
8. Sills: Extruded or machined metal, with grooved surface, 1/4 inch thick.
9. Luminous Ceiling: LED light fixtures and ceiling panels of translucent acrylic or other permanent rigid plastic.
10. Metal Ceiling: Flush panels, with four low-voltage downlights in each panel. Align ceiling panel joints with joints between wall panels.
11. Light Fixture Efficiency: Not less than 35 lumens/W.
12. Ventilation Fan Efficiency: Not less than 3.0 cfm/W.

2.8 HOISTWAY ENTRANCES

A. Hoistway Entrance Assemblies: Manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Frame size and profile shall accommodate hoistway wall construction.

1. Where gypsum board wall construction is indicated, frames shall be self-supporting with reinforced head sections.

B. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies shall comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at as close-to-neutral pressure as possible according to NFPA 252 or UL 10B.

1. Fire-Protection Rating: [**1 hour**] [**1-1/2 hours**] <**Insert rating**>[**with 30-minute temperature rise of 450 deg F**].

C. Materials and Fabrication: Manufacturer's standards, but not less than the following:

1. Enameled or Powder-Coated Steel Frames: Formed from cold- or hot-rolled steel sheet. Provide with factory-applied enamel or powder-coat finish; colors as selected by Architect from manufacturer's full range.
2. Primed or Powder-Coated Steel Frames: Formed from cold- or hot-rolled steel sheet. Provide with factory-applied, rust-resistant primer or powder-coating for field painting.
3. Steel Subframes: Formed from cold- or hot-rolled steel sheet, with factory-applied enamel or powder-coat finish or rust-resistant primer. Fabricate to receive applied finish as indicated.
4. Stainless Steel Frames: Formed from stainless steel sheet.

5. Bronze Frames: Formed from cold- or hot-rolled steel sheet, with enamel or powder-coat finish, and with formed-bronze sheet laminated to steel frames using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
6. Star of Life Symbol: Identify emergency elevators with star of life symbol, not less than 3 inches high, on both jambs of hoistway door frames.
7. Enameled or Powder-Coated Steel Doors[**and Transoms**]: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel or powder-coat finish; colors as selected by Architect from manufacturer's full range.
8. Primed or Powder-Coated Steel Doors[**and Transoms**]: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied, rust-resistant primer or powder-coating for field painting.
9. Stainless Steel Doors[**and Transoms**]: Flush, hollow-metal construction; fabricated [**from stainless steel sheet**] [**or**] [**by laminating stainless steel sheet to exposed faces and edges of enameled or powder-coated steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning**].
10. Bronze Doors[**and Transoms**]: Flush, hollow-metal construction; fabricated by laminating bronze sheet to exposed faces and edges of enameled or powder-coated steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
11. Plastic-Laminate Doors[**and Transoms**]: Flush, hollow-metal construction; fabricated by laminating plastic laminate to exposed faces of enameled or powder-coated steel doors and covering edges with protective edge trim[**matching door frames**]. Plastic-laminate color, texture, and pattern as selected by Architect from [**plastic-laminate**] [**elevator**] manufacturer's full range.
12. Unfinished-Steel Doors[**and Transoms**]: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet, with factory-applied enamel or powder-coating.
13. Sight Guards: Provide sight guards on doors matching door edges.
14. Sills: Extruded or machined metal, with grooved surface, 1/4 inch thick.
15. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M.

2.9 SIGNAL EQUIPMENT

A. Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Provide buttons and lighted elements illuminated with LEDs.

B. Car-Control Stations: Provide manufacturer's standard recessed car-control stations. Mount in return panel adjacent to car door unless otherwise indicated.

1. Mark buttons and switches for required use or function. Use both tactile symbols and Braille.
2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.

C. Emergency Communication System: Two-way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.

D. Firefighters' Two-Way Telephone Communication Service: Provide flush-mounted cabinet in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in Section 28 46 21.11 "Addressable Fire-Alarm Systems."

E. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car-control station. Also, provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served. Include travel direction arrows if not provided in car-control station.

F. Hall Push-Button Stations: Provide one hall push-button station at each landing.

1. Provide manufacturer's standard wall-mounted units.
2. Equip units with buttons for calling elevator and for indicating desired direction of travel.

G. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide one of the following:

1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.
2. Units with flat faceplate for mounting with body of unit recessed in wall and with illuminated elements projecting from faceplate for ease of angular viewing.

H. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.

1. At manufacturer's option, audible signals may be placed on cars.

I. Standby Power Elevator Selector Switches: Provide switches, as required by ASME A17.1/CSA B44, where indicated. Adjacent to switches, provide illuminated signal that indicates when normal power supply has failed.

J. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire, elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.

K. All push buttons and fixtures shall be vandal-resistant.

2.10 FINISH MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, commercial steel, Type B, exposed, matte finish.

B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, commercial steel, Type B, pickled.

C. Stainless Steel Sheet: ASTM A240/A240M, Type 304.

D. Stainless Steel Bars: ASTM A276, Type 304.

E. Stainless Steel Tubing: ASTM A554, Grade MT 304.

F. Aluminum Extrusions: ASTM B221, Alloy 6063.

G. Plastic Laminate: High-pressure type complying with NEMA LD 3, Type HGS for flat applications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Examine hoistways, hoistway openings, and pits as constructed; verify critical dimensions; and examine supporting structure and other conditions under which elevator work is to be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

3.2 INSTALLATION

A. Comply with manufacturer's written instructions.

B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.

C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.

D. Lubricate operating parts of systems, including ropes, as recommended by manufacturers.

E. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

F. Leveling Tolerance: 1/8 inch, up or down, regardless of load and travel direction.

G. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.

H. Locate hall signal equipment for elevators as follows unless otherwise indicated:

1. Place hall lanterns either above or beside each hoistway entrance.

3.3 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.

B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

3.4 PROTECTION

A. Temporary Use: Comply with the following requirements for each elevator used for construction purposes:

1. Provide car with elevator pads with grommets and wall studs.
2. Provide strippable protective film on entrance and car doors and frames.
3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
5. Do not load elevators beyond their rated weight capacity.
6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to instruct Owner's personnel in proper use and operation of elevators. Refer to Section 01 79 00 Demonstration and Training.

1. Review emergency provisions and procedures to be followed at time of operational failure and other building emergencies.

B. Check operation of each elevator with Owner's personnel present before date of Material Completion and again not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

3.6 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 24 months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication,

cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Perform maintenance during normal working hours.
2. Perform emergency callback service during normal working hours with response time of two hours or less.

END OF SECTION 14 21 23.16

SECTION 21 01 10 – FIRE PROTECTION GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

B. It is recognized that separate sub-contracts may be instituted by THIS CONTRACT'S GENERAL CONTRACTOR with others. It is the responsibility of THIS CONTRACT'S GENERAL CONTRACTOR to completely inform, coordinate and advise those sub-contractors as to all of the requirements, conditions and information associated with providing and installing their portion of the total job.

1.2 IMPOSED REGULATIONS:

A. Applicable provisions of the State and Local Codes and of the following codes and standards in addition to those listed elsewhere in the specifications are hereby imposed on a general basis for plumbing work. In each case, the prevailing edition shall be the current adopted edition of the state where the project is located.

1. *International Fire Code*.
2. *NFPA Documents*.

1.3 SCOPE OF WORK:

A. Provide all labor, materials, equipment and supervision to construct complete and operable fire protection systems as indicated on the drawings and specified herein. All materials and equipment used shall be new, undamaged and free from any defects.

1.4 EXISTING SERVICES AND FACILITIES:

A. Damage to Existing Services: Existing services and facilities damaged by the Contractor through negligence or through use of faulty materials or workmanship shall be promptly repaired, replaced, or otherwise restored to previous conditions by the Contractor without additional cost to the Owner.

B. Interruption of Services: Interruptions of services necessary for connection to or modification of existing systems or facilities shall occur only at prearranged times approved by the Owner. Interruptions shall only occur after the provision of all temporary work and the availability of adequate labor and materials will assure that the duration of the interruption will not exceed the time agreed upon.

C. Removed Materials: Existing materials made unnecessary by the new installation shall be removed, shall remain the property of the Owner and shall be stored at a location and in a

manner as directed, or, if classified by the Owner's authorized representative as unsuitable for further use, shall become the property of the Contractor and shall be removed from the site.

1.5 PRODUCT WARRANTIES:

A. Provide manufacturer's standard printed commitment in reference to a specific product and normal application, stating that certain acts of restitution will be performed for the Purchaser or Owner by the manufacturer, when and if the product fails within certain operational conditions and time limits. Where the warranty requirements of a specific specification section exceed the manufacturer's standard warranty, the more stringent requirements will apply and modified manufacturer's warranty shall be provided. In no case shall the manufacturer's warranty be less than one (1) year.

1.6 PRODUCT SUBSTITUTIONS:

A. General: Materials specified by manufacturer's name shall be used unless prior approval of an alternate is given by addenda. Requests for substitutions must be received in the office of the Architect at least 10 days prior to opening of bids.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT REQUIREMENTS:

A. Standard Products: Provide not less (quality) than manufacturer's standard products, as specified by their published product data. In addition to the indication that a particular product/model number is acceptable, comply with the specified requirements. Do not assume that the available off-the-shelf condition of a product complies with the requirements; as an example, a specific finish or color may be required.

B. Uniformity: Where multiple units of a general product are required for the work, provide identical products by the same manufacturer, without variations except for sizes and similar variations as indicated.

C. Product Compatibility, Options: Where more than one product selection is specified, either generically or proprietarily, selection is Purchaser's or Installer's option. Provide adaptations as needed for interfacing of selected products in the work.

D. Equipment Nameplates: Provide a permanent operational data nameplate on each item of power operated equipment, indicating the manufacturer, product name, model number, serial number, speed, capacity, power characteristics, labels of tested compliance, and similar essential operating data.

E. Locate nameplates in easy-to-read locations. When product is visually exposed in an occupied area of the building, locate nameplate in a concealed position (where possible) which is accessible for reading by service personnel.

PART 3 - EXECUTION

3.1 PRODUCT INSTALLATION, GENERAL:

A. Except where more stringent requirements are indicated, comply with the product manufacturer's installation instructions and recommendations, including handling, anchorage, assembly, connections, cleaning and testing, charging, lubrication, startup, test operation and shut-down of operating equipment. Consult with manufacturer's technical experts, for specific instructions on unique product conditions and unforeseen problems.

B. Protection and Identification: Deliver products to project properly identified with names, models numbers, types, grades, compliance labels and similar information needed for distinct identifications; adequately packaged or protected to prevent deterioration during shipment, storage and handling. Store in a dry, well ventilated, indoor space, except where prepared and protected by the manufacturer specifically for exterior storage.

C. Permits and Tests: Provide labor, material and equipment to perform all tests required by the governing agencies and submit a record of all tests to the Owner or his representative. Notify the Architect five days in advance of any testing.

END OF SECTION 21 01 10

SECTION 21 01 20 – FIRE PROTECTION STANDARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:

A. Industry Standards: It is a general requirement that fire protection work comply with applicable requirements and recommendations of standards published by listed agencies and trade associations, except to the extent more detailed and stringent requirements are indicated or required by governing regulations. Listing of Associations, Standards, and Abbreviations:

1.	AWS	American Welding Society, Inc. 2501 NW 7th St., Miami, FL 33125 305/642-7090
2.	CISPI	Cast Iron Soil Pipe Institute 2020 K. St., NW, Washington, DC 202/233-4536
3.	NEC	National Electrical Code by NFPA
4.	NEMA	National Electrical Manufacturers Association 1300 N 17th Street, Suite 1847 Rosslyn, VA 22209 703/841-3200
5.	NFPA	National Fire Protection Association 407 Atlantic Ave., Boston, MA 02210 617/482-8755
6.	UL	Underwriters' Laboratories, Inc. 207 East Ohio St., Chicago, IL 60611 312/642-6969

PARTS 2 AND 3 - PRODUCTS AND EXECUTION (Not applicable)

END OF SECTION 21 01 20

SECTION 21 02 10 – FIRE PROTECTION COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:

A. Coordinate the actual location of all fire protection work visible in finished spaces with the Architect/Engineer.

PART 2 - PRODUCTS

2.1 PRODUCT COORDINATION:

A. Power Characteristics: Refer to the electrical sections of the specifications and the electrical drawings for the power characteristics available for the operation of each power driven item of equipment. The electrical design was based on the typical power requirements of the equipment manufacturers scheduled or specified. Any modifications to the electrical system which are required due to the use of an approved equivalent manufacturer shall be made at no additional cost to the owner. All changes must be clearly documented and submitted for review by the Architect/Engineer prior to purchasing equipment. Coordinate purchases to ensure uniform interface with electrical work. The fire protection contractor shall furnish a detailed list of equipment electrical characteristics to the electrical contractor for the purpose of preparing the coordination affidavit required by Division 26.

B. Coordination of Options and Substitutions: Where the contract documents permit the selection from several product options, and where it becomes necessary to authorize a substitution, do not proceed with purchasing until coordination of interface of equipment has been checked and satisfactorily established.

C. Firestopping: Refer to architectural drawings for the locations of all fire rated ceilings, floors and walls. The contractor shall furnish detailed shop drawings of all firestopping details to be used for both piping and ductwork. All firestopping details shall be U.L. listed and subject to approval by the State Fire Marshal.

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION:

A. Substrate Examination: The Installer of each element of the work must examine the

condition of the substrate to receive the work, and the conditions under which the work will be performed, and must notify the Contractor in writing of conditions detrimental to the proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

B. Do not proceed with the installation of sleeves, anchors, hangers, roof penetrations and similar work until coordination drawings have been processed and released for construction. Where work must be installed prior to that time in order to avoid a project delay, review proposed installation in a project coordination meeting including all parties involved with the interfacing of the work.

3.2 CUTTING AND PATCHING:

A. Structural Limitations: Do not cut structural framing, walls, floors, decks and other members intended to withstand stress, except with the Architect's or Engineer's written authorization. Authorization will be granted only where there is not other reasonable method for completing the work, and where the proposed cutting clearly does not materially weaken the structure.

B. Where authorized, cut opening through concrete (for pipe penetrations and similar services) by core drilling or sawing. Do not cut by hammer-driven chisel or drill.

C. Other work: Do not endanger or damage other work through the procedures and processes of cutting to accommodate mechanical work. Review the proposed cutting with the Installer of the work to be cut, and comply with his recommendations to minimize damage. Where necessary, engage the original Installer or other specialists to execute the cutting in the recommended manner.

D. Where patching is required to restore other work, because of either cutting or other damage inflicted during the installation of fire protection work, execute the patching in the manner recommended by the original Installer. Restore the other work in every respect, including the elimination of visual defects in exposed finishes, as judged by the Architect. Engage the original Installer to complete patching of the following categories of work:

1. Exposed concrete finishes.
2. Exposed masonry.
3. Waterproofing and vapor barriers.
4. Roofing, flashing and accessories.
5. Interior exposed finishes and casework, where judged by the Architect to be difficult to achieve an acceptable match by other means.

3.3 COORDINATION OF FIRE PROTECTION INSTALLATION:

A. General: Sequence, coordinate and integrate the various elements of fire protection work so that building systems will perform as indicated and be in harmony with other work of the building. The Architect/Engineer will not supervise the coordination, which is the exclusive responsibility of the Contractor. Comply with the following requirements:

1. Install piping and similar services straight and true, aligned with other work and with overhead structures and allowing for insulation where applicable. Conceal where

possible.

2. Arrange work to facilitate maintenance and repair or replacement of equipment. Locate services requiring maintenance on valves and similar units in front of services requiring less maintenance. Connect equipment for ease of disconnecting, with minimum of interference with other work.
3. Give the right-of way to piping systems required to slope for drainage (over other service lines). Piping shall be located to avoid interference with ductwork and light fixtures.
4. Store materials off the ground and protected from standing water and weather.

B. Drawings: Conform with the arrangement indicated by the contract documents to the greatest extent possible, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, comply with the Architect's decision on resolution of the conflict.

C. Electrical Work: Coordinate the fire protection work with electrical work, and properly interface with the electrical service. In general, and except as otherwise indicated, install fire protection equipment ready for electrical connection. Refer to electrical sections of the specifications for electrical connection of fire protection equipment.

D. Utility Connections: Coordinate the connection of fire protection systems with exterior underground utilities and services. Comply with the requirements of governing regulations, franchised service companies and controlling agencies. Provide a single connection for each service except where multiple connections are indicated.

END OF SECTION 2 102 10

SECTION 21 022 0 – FIRE PROTECTION SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUBMITTAL FORMS AND PROCEDURES:

A. The purpose of submittals is to demonstrate to the Architect/Engineer that the Contractor understands the design concept. The Architect/Engineer's review of such drawings, schedules, or cuts shall not relieve the Contractor from responsibility for deviation from drawings or specifications unless he has, in writing, called the Architect/Engineer's attention to such deviations at the time of submission, and has received from the Architect/Engineer, in writing, permission for such deviations. All submittals must be completely checked by the Contractor prior to submission for review.

B. Hard Copy Submittals: Submittal data shall be placed in one or more hard-back 3-ring binders, arranged and labeled according to specification section. Each binder shall contain a title page and table of contents. Provide separator tabs, and label by specification section. Make note in the table of contents, any drawings that accompany the submittal. Title page shall contain Project Name, Contractor’s Name, Division 21 Superintendent’s name, Suppliers and point of contact for each, and date. Except as otherwise indicated in other sections, submit 5 complete copies. Quantity indicated does not include copies required for regulatory agencies.

C. Electronic Submittals: If the Architect agrees to allow electronic submittals via an on-line information management product such as “Submittal Exchange, etc., all electronic submittal files shall be organized to match the bid documents for specification section and name. Each submittal file shall be complete for each specification section. Multiple partial submittals per specification section will be rejected. Make note in the table of contents, any drawings that accompany the submittal. Title page shall contain Project Name, Contractor’s Name, Division 21 Superintendent’s name, Suppliers and point of contact for each, and date.

D. Submittals shall be made for all items contained in the following specification sections:

1. Fire Protection Coordination
2. Fire Protection Identification
3. Fire Protection Pipe, Tube, and Fittings
4. Fire Protection Hangers and Supports
5. Fire Protection Seismic Control
6. Fire Protection Sprinkler System
7. Hydraulic Calculations

E. Response to Submittals: A Submittal Review Report shall be issued by the Architect/Engineer with the following classifications for each item:

1. "No Exceptions Taken": No corrections, no marks. Contractor shall submit copies for distribution.
2. "Make Corrections Noted": A few minor corrections. Items may be ordered as marked up without further resubmission. Submit copies for distribution.
3. "Revise and Resubmit": Minor corrections. Item may be ordered at the Contractor's option. Contractor shall resubmit drawings with corrections noted.
4. "Rejected": Major corrections or not in accordance with the contract documents. No items shall be ordered. Contractor shall correct and resubmit drawings.

PART 2 - PRODUCTS

2.1 SUBMITTAL REQUIREMENTS:

A. General: Each specification section shall list the required submittal items. All submittal items shall conform to the requirements listed below. For each major section of submittal data, include a summary page which lists items and model numbers for each piece of equipment.

B. Shop Drawings: Prepare shop drawings to accurate scale except where diagrammatic representations are specifically indicated. Show clearance dimensions of critical locations, and show dimensions of spaces required for operation and maintenance of equipment. Show piping connections and other service connections, and show interface with other work including structural support. Indicate by note, the portions of fire protection work shown on the shop drawings which deviated from the indication of work in the contract documents, and explain the reasons for the deviations. Show how such deviations coordinate with interfacing deviations on shop drawings for other portions of the work, currently or previously submitted.

C. Manufacturer's Data: Where pre-printed data is submitted for more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy with black pen to indicate which of the variations is to be provided. Delete or mark-out significant portions of preprinted data which are not applicable. Where operating ranges are shown, mark data to show portion of range required for project application. Expansion or elaboration of standard data to describe a non-standard product must be processed as a shop drawing submittal. For each product include the manufacturer's production specifications, installation or fabrication instructions, nearest source of supply (including telephone number), sizes, weights, speeds, operating capacities, piping and service line connection sizes and locations, statements of compliance with required standards and governing regulation (include manufacturer's signed statements if not covered in printed data), performance data (where applicable) and similar information needed to confirm compliance with the requirements.

D. Certifications: Where specifically indicated, submit with notarized execution.

E. Test Reports: Submit test reports which have been signed and dated by the firm performing the test and prepared in the manner specified in the standard or regulation governing the test procedures as indicated.

F. Manufacturer's Product Warranties: Where pre-printed and published warranty includes

substantial deviation from required warranty (as judged by the Architect or Engineer), product is automatically disqualified from use on the project, except where manufacturer prepares and issues a specific product warranty on the product, stating that it is in lieu of the published warranty, and is executed by an authorized officer, and complies with the requirements. Warranties shall comply with the requirements of individual specification section where those requirements exceed the manufacturer's standard warranty.

PART 3 - EXECUTION

3.1 CLOSEOUT REQUIREMENTS:

A. Operating Instructions: Submit manufacturer's operating instructions for each item of fire protection equipment and supplement with additional project application instructions where necessary. Prepare and submit specific operating instructions for charging, start-up, control or sequencing of operation, phase or seasonal variations, shut-down, safety and similar operational instructions. Prepare in typewritten form in completely explained and easily understood English language.

B. Maintenance Manuals: Organize each copy of the required system maintenance manuals to include an index followed by thumb-tab marked sections for each of the following:

1. System operating instructions.
2. Emergency instructions including addresses and telephone numbers of service sources.
3. Regular system maintenance procedures including lubrication.
4. Spare parts listing and stocking recommendations.
5. Inspection, adjusting, rebalancing, cleaning, parts replacement, and similar maintenance instructions and recommendations, including the proper use of tools and accessories.
6. Valve schedule and control diagram for each system.
7. Manufacturer's data for each operating item in each system.
8. Manufacturer's product warranties and guarantees relating to the system and equipment items in the system.
9. Corrected or approved issues of submittal items relating to the system.
10. Bind each maintenance manual in one or more vinyl-covered, 2", 3-ring binder, plus pocket-folder type binders for folded drawings, and mark the back spine of each binder with system identification and volume number.

C. Maintenance Materials: Deliver to Owner’s representative at the location as directed, in containers or packages suitable for storage and fully identified.

D. Guarantees: Where indicated as "Certified", provide guarantee which, in addition to execution by an authorized officer of each guarantor, is attested to by the Secretary of each guarantor and bears the corporate seal.

END OF SECTION 21 02 20

SECTION 21 02 30– FIRE PROTECTION IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:

A. Manufacturers: Firms regularly engaged in the manufacture of identification systems required for this product.

B. Submittals: Submit manufacturer's data on materials and submit a sample of each type required.

PART 2 - PRODUCTS

2.1 FIRE PROTECTION IDENTIFICATION MATERIALS:

A. Plastic Pipe Markers:

1. General: Product manufacturer's standard pre-printed, flexible or semi-rigid, permanent, color-coded, plastic-sheet pipe markers, complying with ANSI A13.1.
2. Small Pipe: For external diameters less than 6 inches, provide full band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
   a. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
   b. Adhesive lap joint in pipe marker overlap.
   c. Laminated or bonded application of pipe marker to pipe.
   d. Taped to pipe with color-coded plastic adhesive tape, not less than 3/4 inch wide; full circle at both ends of pipe marker, tape lapped 1-1/2 inch.
3. Large Pipes: For external diameters of 6 inches and larger, provide either full-band or strip-type pipe markers, but not narrower than 3 x letter height (and of required length), fastened by one of the following methods:
   a. Laminated or bonded application of pipe marker to pipe.
   b. Taped to pipe with color-coded plastic adhesive tape, not less than 1-1/2 inches wide: full circle at both ends of pipe marker, tape lapped 3 inches.
4. Lettering: Comply with piping system names as specified, scheduled or shown, and abbreviate only as necessary for each application length.
5. Arrows: Print each pipe marker with arrow indicating direction of flow, either integrally with piping system service lettering or as separate unit of plastic (to accommodate both directions).

6. Install pipe markers on piping of the following piping systems:

   Automatic Wet Pipe Sprinkler System Water

B. Plastic Tape: Manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.

1. Width: Provide 1-1/2 inches wide tape markers on pipes with outside diameters of less than 6 inches, 2-1/2 inches wide tape on larger pipes.
2. Color: Comply with ANSI A13.1.

C. Engraved Plastic-Laminate Signs:

1. General: Provide engraving stock melamine plastic laminated, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core, letter color, except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
2. Thickness: 1/16 inch, except as otherwise indicated.
3. Fasteners: Self-tapping stainless steel screws, except contact type permanent adhesive where screws cannot or should not penetrate the substrate.

D. Valve Tags:

1. Valve tags shall be 18 gauge (minimum) brass with 1-1/4" (minimum) height and width. Identification letters and numbers shall be stamped in tag and shall be filled with black paint
2. Valve tags shall be attached to valve using cable ties. Cable ties shall be self-locking nylon ties.
3. Valve tags shall be installed at all shut-off, balancing, metering, and drain valves. Valve tag shape and designations shall with NFPA and UL.

E. Valve Charts:

1. Valve charts shall be provided for fire protection systems. Charts shall be located at the riser.
2. Valve charts shall be typed listing all valve tags. List shall include identification number, valve location in system (e.g., Corridor 123, etc.) and its function (e.g., shut-off, balancing, drain, etc.). Charts shall be mounted in a wooden frame with glass cover.

2.2 LETTERING AND GRAPHICS:

A. General: Coordinate names, abbreviations and other designations used in the identification work, with the corresponding designations shown, specified or scheduled. Provide numbers, lettering recommended by manufacturers or as required for proper identifications and operation/maintenance of the systems and equipment.

B. Multiple Systems: Where multiple systems of the same generic name are shown and

specified, provide identification which indicates the individual system number as well as the service.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION:

A. Coordination: Where identification is to be applied to surfaces which require painting and other covering or finish, including valve tags in finished spaces, install identification after completion of covering or painting.

B. Piping System Identification:

1. General: Install pipe markers on each system indicated to receive identification, and include arrows to show normal direction of flow.

C. Locate pipe markers as follows wherever piping is exposed to view in mechanical rooms, accessible maintenance spaces (including accessible areas above ceilings) and exterior non-concealed locations:

1. Near each valve and control device.
2. Near each branch, excluding short take-offs for fixtures. Mark each pipe at branch, where there could be a question of flow pattern.
3. Near locations where pipes pass through walls or ceilings, or enter non-accessible enclosures.
4. Near major equipment items and other points of origination and termination.
5. Spaced intermediately at maximum spacing of 50 feet along each piping run, except reduce spacing to 25 feet in congested areas of piping and equipment.

D. Do not mark piping exposed in finished occupied spaces.

E. Fire protection Equipment Identification: Install an engraved plastic laminate sign on or near each major item of fire protection equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for all major items of fire protection equipment.

F. Valve tags shall be attached to the valve handwheel with cable ties.

END OF SECTION 21 02 30

SECTION 21 02 40 – FIRE PROTECTION WORK CLOSEOUT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DOCUMENTATION PROCEDURES:

A. Signed Commitments: Do not proceed with transfer of fire protection systems to the Owner for operation until warranties, performance certifications and similar commitments to be signed by Contractor and other entities have been executed and transmitted to Architect (for Owner's records).

1.3 RECORD DRAWINGS:

A. Explanation: Except where otherwise indicated, fire protection drawings (contract drawings) prepared by Architect/Engineer, contract/drawings, are diagrammatic in nature and may not show locations accurately for various components of fire protection systems. Shop drawings, including coordination drawings, prepared by Contractor shall show certain portions of work more accurately to scale and location, and in greater detail.

B. General Recording Procedure: Maintain a white-print set, blue-line or black-line, of fire protection contract drawings and shop drawings in clean, undamaged condition, for mark-up of actual installations which vary substantially from the work as shown. Mark-up whatever drawings are most capable of showing the installed conditions accurately; however, where shop drawings are marked, record a reference note on appropriate contract drawing. Mark with erasable pencil and use multiple colors to aid in the distinction between work of separate systems. In general, record every substantive installation of fire protection work which previously is either not shown or shown inaccurately, but in any case record the following:

1. Underground and aboveground piping, both exterior and interior, drawn to scale and fully dimensioned.
2. Fire Protection "Project Record" shall be maintained as part of the "Project Record" specified in Division 1.

PART 2 – PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 CLOSEOUT PROCEDURES:

A. General Coordination: Sequence closeout procedures properly, so that work will not be endangered or damaged, and so that every required performance will be fully tested and demonstrated.

B. System Performance Test Run: At the time of fire protection work closeout, check each item in each system to determine that it is set for proper operation. With Owner's representative and Architect/Engineer present, operate each system in a test run of appropriate duration to demonstrate compliance with performance requirements. During or following test runs, make final corrections or adjustments of system to refine and improve performances wherever possible, including noise and vibration reductions, elimination of hazards, better response of controls, signals and alarms, and similar system performance improvements. Provide testing or inspection devices as may be requested for Architect's/Engineer's observation of actual system performances. Demonstrate that controls and items requiring service or maintenance are accessible. Test run shall be scheduled to coincide with Engineer's final inspection of the fire protection work.

C. Cleaning and Lubrication: After final performance test run of each fire protection system, clean system. Lubricate both power and hand operated equipment and remove excess lubrication. Touch-up minor damage to factory painted finishes and other painting specified as fire protection work; refinish work where damage is extensive.

D. General Operating Instructions: In addition to specified training of Owner's operating personnel specified in individual fire protection sections, and in addition to preparation of written operating instructions and compiled maintenance manuals specified, provide general operating instructions for the fire protection systems. Conduct a walk-through explanation and demonstration for orientation and education of Owner's personnel to be involved in continued operation of building.

1. Describe each basic system and how its control system functions.
2. Explain and point out identification system, displayed diagrams, signals, alarms and similar provisions of the work.
3. Describe basic sequencing requirements and interlock provisions for system start-up, phasing and shut-down.
4. Emphasize emergency procedures and safety provisions for protection of equipment and safety of occupants during equipment malfunction, disasters, power failures and similar unusual circumstances.
5. Outline basic maintenance procedures.

E. Demonstrate what adjustments have been made and can continue to be made to reduce noise and vibration, improve system output, decrease energy consumption and similar performance improvements.

F. Point out operational security provisions, safety, unavoidable hazards and similar operator limitations. Display and conduct a "thumb-through" explanation of maintenance manuals, record drawings, meter readings and similar service items.

G. Construction Equipment: After completion of performance testing and Owner's operating instructions and demonstrations, remove installers tools, test facilities, construction equipment and similar devices and materials used in execution of the work but not incorporated in the work.

3.2 CONTINUED SYSTEM OPERATIONS:

A. Final Acceptance: At time of substantial completion of fire protection work, Owner's operating personnel will take over operation of fire protection systems. However, until time of final acceptance, respond promptly with consultation and services on whatever operation or maintenance problems may remain or arise.

END OF SECTION 21 02 40

SECTION 21 03 10 – FIRE PROTECTION EXCAVATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:

A. Coordination: Where excavation and backfill for fire protection work passes through or occurs in the same areas as work specified in the Division 2 sections, comply with both the requirements of the Division 2 sections and the requirements of this section, whichever is the more stringent (as determined by the Architect/Engineer in cases of conflicting requirements).

1.3 JOB CONDITIONS:

A. Existing Utilities: Locate and protect existing utilities and other underground work in a manner which will ensure that no damage or service interruption will result from excavating and backfilling.

PART 2 - PRODUCTS

2.1 BACKFILL MATERIALS:

A. Subbase Material: A graded mixture of gravel, sand, crushed stone or crushed slag.

PART 3 - EXECUTION

3.1 EXCAVATING:

A. Inspection: The excavator must examine the areas to be excavated, and the conditions under which the work is to be performed, and notify the Contractor in writing of conditions detrimental to the proper completion of the work. Do not proceed with excavating until unsatisfactory conditions have been corrected in a manner acceptable to the excavator.

B. General:

1. Do not excavate until the work is ready to proceed without delay, so that the total time lapse from excavation to completion of backfilling will be minimum.
2. Provide signs, illuminations and barricades as necessary to prevent accidents at

excavations.

3. Excavate with vertical sided excavations to the greatest extent possible, except where otherwise indicated. Where necessary, provide sheeting and cross-bracing to sustain sides of excavations. Remove sheeting and cross-bracing during backfilling wherever such removal would not endanger the work or other property. Where not removed, cut sheeting off at a sufficient distance below finished grade to not interfere with other work.
4. Excavate for piping with 6" to 9" clearance both sides of pipe, except where otherwise shown or required for proper installation of pipe joints, fittings, valves and other work. Provide a minimum of 12" clearance around underground tanks.
5. For work to be supported directly on undisturbed soil, do not excavate beyond required depths, and hand excavate the bottom cut to accurate elevations. Except as otherwise indicated, support the following work on undisturbed soil at the bottom of the excavations:
   a. Piping of 5" and less pipe/tube size.
   b. Cast-in-place concrete.
6. Where directed, excavate additional depth to reach satisfactory soil-bearing conditions. Backfill with subbase material, compacted as directed, to indicated excavation depth.
7. Except as otherwise indicated, excavate for exterior water-bearing piping so that the top of piping will not be less than 2'- 0" vertical distance below finished grade.
8. Store excavated material (temporarily) near the excavation, in a manner which will not interfere with or damage the excavation or other work.
   a. Retain excavated material which complies with the requirements for backfill material.
   b. Dispose of excavated material which is either in excess of quantity needed for backfilling or does not comply with requirement for backfill material.

3.2 DEWATERING:

A. Maintain dry excavations by removing water. Pump minor inflow of ground water from excavations; protect excavations from major inflow of ground water by installing temporary sheeting and waterproofing. Provide adequate barriers which will protect other excavations from being damaged by water, sediment or erosion from or through excavations.

3.3 BASE PREPARATION:

A. Install subbase material to receive fire protection work, and compact by tamping to form a firm base for the work. For piping, shape the subbase to fit the shape of the bottom 90 degrees of the cylinder, for uniform continuous support.

B. Shape subbases and bottoms of excavations with recesses to receive pipe bells, flanges connections, valves and similar enlargements in the piping systems.

3.4 BACKFILLING:

A. Do not backfill until installed work has been tested and accepted, wherever testing is indicated.

B. Condition backfill material by either drying or adding water uniformly, to whatever extent

may be necessary to facilitate compaction to the required densities. Do not backfill with frozen soil materials.

C. Backfill simultaneously on opposite sides of work, and compact simultaneously; do not dislocate the work from installed positions.

D. Backfill excavations in 8" high courses of backfill material, uniformly compacted to the following densities (percent of maximum density, ASTM Standard Proctor), using power-driven hand-operated compaction equipment.

1. Lawn/Landscaped Areas: 90%
2. Roadways: 95%
3. Paved Area, Other than Roadways: 95%

E. Backfill to elevations matching adjacent grades, at the time of backfilling excavations for mechanical work.

F. Where compaction tests indicate lower densities of backfill than specified, continue compaction (and re-excavation and backfilling where necessary) and provide additional testing as directed by the Architect/Engineer.

3.5 PERFORMANCE AND MAINTENANCE:

A. Where subsidence is measurable or observable at fire protection work excavations during the guarantee period, remove the surface (pavement, lawn or other finish), add backfill material, compact and replace the surface treatment. Restore the appearance, quality and condition of the surface or finish to match adjacent work, and eliminate evidence of the restoration to the greatest extent possible.

END OF SECTION 21 03 10

SECTION 21 20 10 - FIRE PROTECTION SPRINKLER SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SCOPE:

A. Fire Protection Supply Pipe: Route the building fire main to the city water main and connect to the supply line at the appropriate time and location. Contractor shall field verify exact location of water main prior to start of construction.

B. Work Includes but is not limited to:

1. Installing a complete "wet pipe" Automatic Sprinkler system throughout the building including mansard roof areas.
2. Install a complete Class I Standpipe system in the stairwells.
3. Install a complete fire pump system.

C. Related Work Specified Elsewhere:

1. Wiring of flow alarm switches and tamper switches and connection of switches to building alarm system are specified in Section 271010.

D. Sprinkler Design Requirements:

1. The sprinkler system shall be a wet pipe type. The design area shall be the most remote 1500 square feet. The design density for light hazard shall be .10 gpm/ft^2. Hose requirement for light hazard shall be 100 gpm. The design density for ordinary hazard – group 1 shall be .15 gpm/ft^2. Hose requirement for ordinary hazard – group 1 shall be 250 gpm. The design density for ordinary hazard – group 2 shall be .20 gpm/ft^2. Hose requirement for ordinary hazard – group 2 shall be 250 gpm.
2. The contractor shall submit 4 complete sets of sprinkler shop drawings and hydraulic calculations to the architect for review, prior to ordering material and/or cutting pipe. Contractor shall not cut any piping until shop drawings have been reviewed and accepted. The contractor shall show in dashed lines the location of all ductwork, lights and diffusers.
3. The contractor shall be responsible for coordinating sprinkler piping and heads locations with other trades. Contractor shall relocate sprinkler piping and heads as necessary in order to avoid conflict with ductwork, lights and structure.
4. Provide auxiliary drains at low points in system and for trapped sections as required by NFPA-13. Locate auxiliary drains in mechanical closets or other locations out of sight.
5. The contractor shall include a ten pound (10 psi) buffer in the hydraulic calculations, i.e. the pressure required for the sprinkler system (including hose stream) shall be a minimum of 10 psi less than the available pressure at the required flow.

6. The contractor shall perform a flow test prior to commencing design and shall provide test information to the Architect for approval. Sprinkler system design shall be based upon the contractor's flow test.

1.3 QUALITY CRITERIA:

A. Permits, Licenses, Inspection Fees:

1. Obtain and pay for permits, licenses and inspection fees as may be required for performance and approval of the work performed under this section of the specifications.
2. Comply with all requirements of NFPA 13, NFPA 14, NFPA 20, NFPA 24 and the State Fire Marshall and local codes.

B. Materials: Materials specified by manufacturer's name shall be used unless prior approval of a substitute is given by addenda.

1.4 SUBMITTALS:

A. Before materials and equipment are purchased, submit for Architect's approval, a complete schedule of materials and equipment to be incorporated in the work. Submittals shall include the following:

1. Complete Shop Drawings with hydraulic calculations
2. All Valves
3. Fire Department Connections
4. Sprinkler Heads
5. Tamper Switches
6. Pipe Hangers and Supports
7. Pipe and Fittings
8. Cabinets
9. Access Panels
10. Alarm Valve
11. Fire Pump and Accessories
12. Jockey Pump and Accessories
13. Dry Pipe Valve and Accessories

B. Grooved joint couplings and fittings shall be shown on drawings and product submittals, and be specifically identified with the applicable style number.

C. Sprinkler heads shall be referred to on drawings, submittals and other documentation, by the sprinkler identification or model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.

1.5 TESTING PIPE SYSTEMS:

A. Tests shall be conducted in the presence of the Architect or his designated representative. Equipment, materials, and instruments for testing shall be furnished by the Contractor without additional cost to the Owner.

B. Automatic Sprinkler and Standpipe Piping: The automatic sprinkler systems shall be hydrostatically tested in their entirety or in zones defined by shut-off valves. The piping shall be tested at a pressure of 200 psig, measured at the low point in the system or zone, and shall be proved tight at this pressure for a period of not less than two hours. Leaks detected shall be repaired by tightening, rewelding joints, or replacing damaged pipe or fittings. Caulking of joints will not be permitted.

C. Dry Pipe Air Test: All dry pipe piping shall be tested at 40 psig and allowed to stand for 24 hours. All leaks which allow a loss of pressure over 1½ psi shall be repaired.

1.6 OPERATION AND MAINTENANCE INSTRUCTIONS:

A. Operating and Maintenance Instructions, printed and bound in hard cover three ring loose leaf notebooks, shall be provided for each item of equipment listed below; 5 separate copies shall be provided. Each notebook shall be provided within an identifying label under a clear plastic cover shield on the front cover which shall identify the Project, Engineer, Contractor and Date.

1. National Fire Protection Association Pamphlet No. 25.
2. Copies of All Approved Submittal Data (listed above under submittals).
3. As-Built copies of Design Drawings and Hydraulic Calculations.

1.7 SEISMIC REQUIREMENTS:

A. Provide seismic protection for the sprinkler system. Design and install seismic protection in accordance with the requirements of NFPA 13 section titled "Protection of Piping Against Damage Where Subject to Earthquakes." Seismic requirements may be waived by the Authority Having Jurisdiction. Provide written documentation of waiver.

1.8 GUARANTEE:

A. All equipment shall be guaranteed as specified under the General and Special Conditions. Guarantee on all equipment shall start and coincide with the Contractor's guarantee obligations.

PART 2 - PRODUCTS AND INSTALLATION

2.1 PIPE AND FITTINGS:

A. Pipe and fittings listed herein shall be for the services indicated.

2.2 SPRINKLER AND STANDPIPE:

A. Piping Options:

1. Schedule 40 black steel pipe: ASTM A-795, A-53, or A-135 with class 150 or 300 pound malleable iron threaded fittings, welded steel fittings, or with mechanical grooved joint couplings. Mechanical couplings for main sprinkler and standpipe risers shall be rigid type coupling.
2. Schedule 10 black steel pipe: ASTM A-135 pipe, UL listed for sprinkler systems. Fittings for thin wall pipe shall be same type specified for Schedule 40 pipe.

2.3 JOINTS:

A. Mechanical grooved joint couplings shall be listed for use in fire protection systems.

1. Grooved End Fittings: Fittings shall be ductile iron (ASTM A536); forged steel (ASTM A234); or fabricated from carbon steel pipe (ASTM A53); with pre-grooved ends for use with mechanical couplings of the same manufacturer.
2. Mechanical Couplings: Coupling housings shall be ductile iron (ASTM A536). Bolts and nuts shall be carbon steel track-type (ASTM A183), minimum tensile 110,000 psi. Gaskets shall be Grade “E” EPDM, for water services from -30 to +230EF. At joints allowing controlled movement, expansion, contraction of deflection, flexible couplings with shall be used. At all joints not requiring flexibility, a rigid coupling shall be used.
   a. Rigid Type: Coupling housings cast with offsetting, angle-pattern bolt pads shall be used to provide system rigidity and support and hanging in accordance with NFPA 13.
   b. Flexible Type: Use in locations where vibration attenuation and stress relief are required.
3. Flange Adapter: Flat face, for direct connection to ANSI Class 125 or 150 flanged components.

B. Welded flanged joints shall be faced true, provided with 1/16 inch ring type gasket, and made square and tight. Flanges shall have raised or flat faces to mate with adjacent flanges or valves. Welding shall comply with ANSI B31.1.

C. Welded joints shall be butt welded in accordance with ANSI B31.1.

D. Qualification of Welders:

1. All welders employed for the work shall be qualified under the requirements of ANSI B31.1.0, Section 127.5.
2. Evidence of the welder’s qualifications shall be submitted to the Architect before any welds are made.
3. Coupling for sprinkler piping shall be Victaulic Model 75.

E. Underground Pipe:

1. Standard weight ductile iron pipe with mechanical "bolted type" joints.
2. Provide tie rods and thrust blocks at each change of direction of the underground fire service piping. Install tie rods and thrust blocks in accordance with NFPA-24 requirements.

2.4 VALVES, EQUIPMENT AND ACCESSORIES FOR FIRE PROTECTION SYSTEM:

A. Gate Valves 2½ Inch and Larger: Valves shall be O.S. and Y type with iron body, bronze trim, solid wedge, and flanged ends for 175 pound W.W.P. Valves shall be U.L. listed with identification mark for such stamped or cast on valve body. Valve shall be Crane, No. 467; Stockham, G-634, Nibco/Scott, F-607-0 or Kennedy, Figure 68.

B. Gate Valves 2 Inches and Smaller: Valves shall be O.S. and Y type with bronze body, solid wedge, and threaded ends for 175 pound W.W.P. Valves shall be U.L. listed with identification mark for such stamped or cast on valve body. Valves shall be Crane, No. 459; Stockham, B-133; Nibco/Scott, T-104-0 or Kennedy, Figure 66.

C. Check Valves 2 Inches in Size and Smaller: Check valves shall be horizontal swing type with bronze body, composition disc, threaded ends for 200 pound W.O.G. and shall be Crane, No. 34-1/2; Stockham, B-305-B; Nibco/Scott, T-413-W or Kennedy, Figure 440.

D. Swing Check Valves 2½ Inch and Larger: Check valves shall be horizontal swing type with iron body, bronze trim, and flanged ends for 175 pound W.W.P. Valves shall be UL listed with identification mark for such stamped or cast on the valve body. Valves shall be Crane, No. 375; Stockham, G-939; Nibco/Scott, F-0908-B or Kennedy, Figure 126.

E. Wafer Check Valves 4 inch and Larger: Valves shall be iron body with bronze trim, EPDM O-ring seals and stainless steel Hinge pins. Valve shall be UL listed and FM approved. Wafer check valves shall be Grinnell Model F512, or equivalent by Victaulic or Gruvlock.

F. Spring-Assisted Check Valves 2½ inch and Larger: Valve shall be UL listed and FM approved. Valves shall have a ductile iron body with aluminum bronze or elastomer encapsulated ductile iron disc, stainless steel spring and shaft and grooved ends. Spring-assisted check valves shall be Victaulic or Gruvlock.

G. Butterfly Valves 2½ inch and Larger: Valve shall be UL listed and FM approved. Valves shall have a ductile iron body, elastomer encapsulated ductile iron disc with integrally cast stem and grooved ends. Butterfly valves shall be Victaulic, Gruvlock, or Kennedy.

H. Globe Valves: Valves shall have bronze body, rising stem, composition disc, threaded ends for 200 pound W.O.G. and shall be Crane, No. 7; Stockham, B-13T; Nibco/Scott, T-211-W or Kennedy, Figure 97.

I. Angle Valves: Valves shall have bronze body, rising stem, composition disc, threaded ends for 200 pound W.O.G. and shall be Crane, No. 17; Stockham, B-222; Nibco/Scott, T-311-W or Kennedy, Figure 98.

J. Supervisory Switches: The valve for each sprinkler system shall be provided with a valve mounted switch capable of detecting motion of the valve from a full open position. Switche shall be Underwriters Laboratories listed and Factory Mutual approved. Switch shall be System Sensor, United Electrics, Potter or Viking.

K. Water Flow Switches: water flow switches shall be line mounted vane type with retard. Switch shall consist of two single pole, double throw, snap action switches and an adjustable, recycling pneumatic retard, contained inside a general purpose die-cast housing. Switches shall be capable of either horizontal or vertical mounting, and shall be Underwriters

Laboratories listed and Factory Mutual approved. Switch shall be System Sensor, United Electrics, Potter or Viking.

L. Electric Bell: Bell shall be 10" round red enameled steel bell 120 Volt A.C. electric motor. Bell shall be Potter-Roemer 6230 or equivalent by Viking, System Sensor or United Electrics.

M. In-Building Riser: In-Building Riser shall be installed as indicated on the plans. Riser shall be composed of a single extended 90 degree fitting of fabricated 304 stainless steel tubing, maximum working pressure 200 psi. The fitting shall have a flanged-end connection on the outlet (building) side and a CIPS coupler on the inlet (underground) side. In-Building Riser shall be Ames Fire & Waterworks Series IBR, Zurn Wilkins WBR or equal by Viking.

N. Riser Manifold Assembly: shall be UL Listed for horizontal or vertical installation as a one-piece, fabricated assembled unit. The riser manifold assembly shall consist of a cast, non-welded, ductile iron body with grooved end connections having all brass and galvanized trim. The manifold piping shall clearly identify manifold pipe size, flow direction, test, drain, and gauge outlets. A built-in drain port shall be available to permit hydrostatic testing without draining the system. Assembly shall have a working pressure rating of 300 psi.

O. Sprinkler Wet Pipe Alarm Valves: Valves shall be U.L. listed and shall be furnished with all standard trim including pressure gauges, by-pass, test valves, electric alarm pressure switch and main drain. Valve shall be cast iron or ductile iron, and all parts in contact with water shall be non-ferrous. Internal parts shall be replaceable without removal of valve from installed position. Valve shall be Victaulic, Central Sprinkler, Viking, Grinnell, Automatic Sprinkler, or Reliant.

P. Sprinkler Dry Pipe Alarm Valves: Valves shall be U.L. listed and shall be furnished with all standard trim including pressure gauges, fill cup, air pressure maintenance device, by-pass, test valves, electric alarm pressure switch and main drain. Valve shall be cast iron or ductile iron, and all parts in contact with water shall be non-ferrous. Internal parts shall be replaceable without removal of valve from installed position. Valve shall be externally resettable. Valve shall be Victaulic, Central Sprinkler, Viking, Grinnell, Automatic Sprinkler or Reliant.

2.5 SPRINKLER HEADS:

A. Sprinkler heads shall be glass-bulb type. Body shall be die cast brass, with hex-shaped wrench boss cast into the body to facilitate installation and reduce the risk of damage during installation.

B. Sprinkler head types shall be coordinated with the Architect.

C. Upright sprinkler heads shall be ½ inch spray type with bronze finish. Sprinklers shall be Viking, Central Sprinkler, Reliable, Grinnell or Automatic Sprinkler.

D. Pendent sprinkler heads unless otherwise indicated pendent sprinkler heads shall be quick response ½ inch spray type with chrome plated finish and white escutcheon plate. Sprinklers shall be Viking, Central Sprinkler, Reliable, Grinnell or Automatic Sprinkler.

E. Dry Pendent sprinkler heads shall be ½ inch recessed type with polished brass finish.

Sprinklers shall be Viking, Central Sprinkler, Reliable, Grinnell or Automatic Sprinkler.

F. Sidewall sprinkler heads shall be quick response ½ spray type with chrome plated finish and white escutcheon. Sprinklers shall be Viking, Central Sprinkler, Reliable, Grinnell or Automatic Sprinkler.

G. Concealed pendent sprinkler heads shall be ½ inch spray type with chrome plated finish and white escutcheon and ceiling plat. Sprinklers shall be Viking, Central Sprinkler, Reliable, Grinnell or Automatic Sprinkler.

H. Attic sprinklers shall be quick response specific application sprinkler heads with bronze finish. Sprinklers shall be Globe GL Series or equivalent by Viking, Central Sprinkler, Reliable, Grinnell or Automatic Sprinkler.

2.6 HANGERS FOR FIRE PROTECTION PIPING:

A. Hanger for 4" and larger horizontal lines shall be Clevis type hangers, B-Line B-3100 or equivalent by Anvil, or Erico.

B. Hanger for horizontal lines up to 3½" shall be band type hangers, B-Line Model B-3172 or equivalent by Anvil, or Erico.

C. Supports for vertical lines passing through floor shall be riser clamp type, Fee & Mason Fig. No. 241, Carpenter and Patterson No. 126 or equivalent by B-Line, Anvil or Erico.

2.7 FIRE DEPARTMENT CONNECTION:

A. The fire department connection shall be a Two way wall mounted type with clappers, caps and chains, and identification base plate. Finish shall be polished brass. Fire department connections shall be Potter Roemer Model 5751 or equivalent by Elkhart or Sierra. Fire department connections shall be 5” locking Storz type.

2.8 FREEZE PROTECTION:

A. Aboveground wet pipes in unheated areas such as the fire service line serving the dry pipe valve shall be protected from freezing by tracing with Raychem self-regulating, heat trace tape, Model 5BTV-C-CR. Heat trace tape shall be spiral wrapped as indicated on the drawings. Pipes shall then be insulated with 1" thick fiberglass insulation with all season jacket. Insulation exposed to weather shall be protected with an aluminum jacket weather sealed.

2.9 FIRE PUMP AND ACCESSORIES:

A. The pump shall be an electrical driven type. The pump shall be selected by the fire sprinkler contractor and based on providing flow to meet the automatic sprinkler demand and pressure requirements. The pump shall meet the requirements of Underwriters' Laboratories, Factory Mutual and NFPA 20. The pump shall be furnished complete with all necessary accessories including but not limited to a controller, jockey pump, jockey pump controller, 2½" test hose valves with caps and chains, hose valve header, suction and discharge gauges, casing relief

valve, main relief valve, automatic air release valve, ball drip valve, gate valves and check valves.

B. Fire pump frame shall be provided with vibration isolation.

C. The pump manufacturer shall provide the services of a factory trained technician for check-out and start-up of the fire pump systems.

2.10 HOSE CABINETS:

A. Fire hose cabinets shall be recessed aluminum valve cabinet, with 100' of 1-1/2" lined fire hose rack DUO-panel glass door and brass fog nozzle. Hose cabinet shall be Potter-Roemer Series 1000-D.

PART 3 - EXECUTION

3.1 GENERAL:

A. Unless specifically stated otherwise, the fire protection system shall conform to all other sections of this specification which apply to pipe installation, accessories and controls.

B. All threaded hose outlets shall comply with the local fire department requirements.

C. All shop drawings submitted on items requiring Underwriters' Listing shall bear evidence of Underwriters' approval.

D. All exposed fire system piping including valve room piping shall be cleaned of rust, grease and scaled and shall be provided with a field applied prime coat and two coats of an oil based enamel paint. Color shall be red or as directed by architect.

E. The contractor shall perform all tests of Fire Protection Systems as required by governing codes and local authorities at no additional cost to the Owner. Tests shall be performed in the presence of the Owners representative.

3.2 INSTALLATION:

A. Install sprinkler piping with a slope to valve room and to auxiliary low point drains as required by NFPA 13.

B. Coordinate sprinkler installation with building structure and other trades.

C. Route drains to outside building and terminate 9" AFG.

D. Verify locations of lights and diffusers prior to installing sprinkler heads and piping.

E. Sprinkler heads shall be installed on centerline with lights, diffusers and doors, in living units. In layin tile ceiling the sprinkler heads shall be installed in the center of 2' x 2' tiles and in the center of the ½ tile in 2' x 4' tiles.

F. Contractor shall purge air from all wet pipe sprinkler system piping prior to final system

completion.

G. Install a spare sprinkler cabinet near the sprinkler riser. Provide number of spare sprinklers as required by NFPA-13, with at least one spare for each type of head installed.

END OF SECTION 21 20 10

SECTION 22 01 10 – PLUMBING GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

B. It is recognized that separate sub-contracts may be instituted by THIS CONTRACT'S GENERAL CONTRACTOR with others. It is the responsibility of THIS CONTRACT'S GENERAL CONTRACTOR to completely inform, coordinate and advise those sub-contractors as to all of the requirements, conditions and information associated with providing and installing their portion of the total job.

1.2 IMPOSED REGULATIONS:

A. Applicable provisions of the State and Local Codes and of the following codes and standards in addition to those listed elsewhere in the specifications are hereby imposed on a general basis for plumbing work. In each case, the prevailing edition shall be the current adopted edition of the state where the project is located.

1. International Plumbing Code.
2. International Energy Conservation Code.
3. International Fire Code.
4. NFPA 54

1.3 SCOPE OF WORK:

A. Provide all labor, materials, equipment and supervision to construct complete and operable plumbing systems as indicated on the drawings and specified herein. All materials and equipment used shall be new, undamaged and free from any defects.

1.4 EXISTING SERVICES AND FACILITIES:

A. Damage to Existing Services: Existing services and facilities damaged by the Contractor through negligence or through use of faulty materials or workmanship shall be promptly repaired, replaced, or otherwise restored to previous conditions by the Contractor without additional cost to the Owner.

B. Interruption of Services: Interruptions of services necessary for connection to or modification of existing systems or facilities shall occur only at prearranged times approved by the Owner. Interruptions shall only occur after the provision of all temporary work and the availability of adequate labor and materials will assure that the duration of the interruption will not exceed the time agreed upon.

C. Removed Materials: Existing materials made unnecessary by the new installation shall be removed, shall remain the property of the Owner and shall be stored at a location and in a manner as directed, or, if classified by the Owner's authorized representative as unsuitable for further use, shall become the property of the Contractor and shall be removed from the site.

1.5 PRODUCT WARRANTIES:

A. Provide manufacturer's standard printed commitment in reference to a specific product and normal application, stating that certain acts of restitution will be performed for the Purchaser or Owner by the manufacturer, when and if the product fails within certain operational conditions and time limits. Where the warranty requirements of a specific specification section exceed the manufacturer's standard warranty, the more stringent requirements will apply and modified manufacturer's warranty shall be provided. In no case shall the manufacturer's warranty be less than one (1) year.

1.6 PRODUCT SUBSTITUTIONS:

A. General: Materials specified by manufacturer's name shall be used unless prior approval of an alternate is given by addenda. Requests for substitutions must be received in the office of the Architect at least 10 days prior to opening of bids.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT REQUIREMENTS:

A. Standard Products: Provide not less (quality) than manufacturer's standard products, as specified by their published product data. In addition to the indication that a particular product/model number is acceptable, comply with the specified requirements. Do not assume that the available off-the-shelf condition of a product complies with the requirements; as an example, a specific finish or color may be required.

B. Uniformity: Where multiple units of a general product are required for the work, provide identical products by the same manufacturer, without variations except for sizes and similar variations as indicated.

C. Product Compatibility, Options: Where more than one product selection is specified, either generically or proprietarily, selection is Purchaser's or Installer's option. Provide adaptations as needed for interfacing of selected products in the work.

D. Equipment Nameplates: Provide a permanent operational data nameplate on each item of power operated equipment, indicating the manufacturer, product name, model number, serial number, speed, capacity, power characteristics, labels of tested compliance, and similar essential operating data.

E. Locate nameplates in easy-to-read locations. When product is visually exposed in an occupied area of the building, locate nameplate in a concealed position (where possible) which is accessible for reading by service personnel.

PART 3 - EXECUTION

3.1 PRODUCT INSTALLATION, GENERAL:

A. Except where more stringent requirements are indicated, comply with the product manufacturer's installation instructions and recommendations, including handling, anchorage, assembly, connections, cleaning and testing, charging, lubrication, startup, test operation and shut-down of operating equipment. Consult with manufacturer's technical experts, for specific instructions on unique product conditions and unforeseen problems.

B. Protection and Identification: Deliver products to project properly identified with names, models numbers, types, grades, compliance labels and similar information needed for distinct identifications; adequately packaged or protected to prevent deterioration during shipment, storage and handling. Store in a dry, well ventilated, indoor space, except where prepared and protected by the manufacturer specifically for exterior storage.

C. Permits and Tests: Provide labor, material and equipment to perform all tests required by the governing agencies and submit a record of all tests to the Owner or his representative. Notify the Architect five days in advance of any testing.

END OF SECTION 22 01 10

SECTION 22 02 10 - PLUMBING COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:

A. Coordinate the actual location of all plumbing work visible in finished spaces with the Architect/Engineer.

PART 2 - PRODUCTS

2.1 PRODUCT COORDINATION:

A. Power Characteristics: Refer to the electrical sections of the specifications and the electrical drawings for the power characteristics available for the operation of each power driven item of equipment. The electrical design was based on the typical power requirements of the equipment manufacturers scheduled or specified. Any modifications to the electrical system which are required due to the use of an approved equivalent manufacturer shall be made at no additional cost to the owner. All changes must be clearly documented and submitted for review by the Architect/Engineer prior to purchasing equipment. Coordinate purchases to ensure uniform interface with electrical work. The plumbing contractor shall furnish a detailed list of equipment electrical characteristics to the electrical contractor for the purpose of preparing the coordination affidavit required by Division 26.

B. Coordination of Options and Substitutions: Where the contract documents permit the selection from several product options, and where it becomes necessary to authorize a substitution, do not proceed with purchasing until coordination of interface of equipment has been checked and satisfactorily established.

C. Firestopping: Refer to architectural drawings for the locations of all fire rated ceilings, floors and walls. The contractor shall furnish detailed shop drawings of all firestopping details to be used for both piping and ductwork. All firestopping details shall be U.L. listed and subject to approval by the Authority having jurisdiction.

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION:

A. Substrate Examination: The Installer of each element of the work must examine the

condition of the substrate to receive the work, and the conditions under which the work will be performed, and must notify the Contractor in writing of conditions detrimental to the proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

B. Do not proceed with the installation of sleeves, anchors, hangers, roof penetrations and similar work until coordination drawings have been processed and released for construction. Where work must be installed prior to that time in order to avoid a project delay, review proposed installation in a project coordination meeting including all parties involved with the interfacing of the work.

3.2 CUTTING AND PATCHING:

A. Structural Limitations: Do not cut structural framing, walls, floors, decks and other members intended to withstand stress, except with the Architect's or Engineer's written authorization. Authorization will be granted only where there is not other reasonable method for completing the work, and where the proposed cutting clearly does not materially weaken the structure.

B. Where authorized, cut opening through concrete (for pipe penetrations and similar services) by core drilling or sawing. Do not cut by hammer-driven chisel or drill.

C. Other work: Do not endanger or damage other work through the procedures and processes of cutting to accommodate mechanical work. Review the proposed cutting with the Installer of the work to be cut, and comply with his recommendations to minimize damage. Where necessary, engage the original Installer or other specialists to execute the cutting in the recommended manner.

D. Where patching is required to restore other work, because of either cutting or other damage inflicted during the installation of plumbing work, execute the patching in the manner recommended by the original Installer. Restore the other work in every respect, including the elimination of visual defects in exposed finishes, as judged by the Architect. Engage the original Installer to complete patching of the following categories of work:

1. Exposed concrete finishes.
2. Exposed masonry.
3. Waterproofing and vapor barriers.
4. Roofing, flashing and accessories.
5. Interior exposed finishes and casework, where judged by the Architect to be difficult to achieve an acceptable match by other means.

3.3 COORDINATION OF PLUMBING INSTALLATION:

A. General: Sequence, coordinate and integrate the various elements of plumbing work so that building systems will perform as indicated and be in harmony with other work of the building. The Architect/Engineer will not supervise the coordination, which is the exclusive responsibility of the Contractor. Comply with the following requirements:

1. Install piping and similar services straight and true, aligned with other work and with overhead structures and allowing for insulation where applicable. Conceal where

possible.

2. Arrange work to facilitate maintenance and repair or replacement of equipment. Locate services requiring maintenance on valves and similar units in front of services requiring less maintenance. Connect equipment for ease of disconnecting, with minimum of interference with other work.
3. Give the right-of way to piping systems required to slope for drainage (over other service lines). Piping shall be located to avoid interference with ductwork and light fixtures.
4. Store materials off the ground and protected from standing water and weather.

B. Drawings: Conform with the arrangement indicated by the contract documents to the greatest extent possible, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, comply with the Architect's decision on resolution of the conflict.

C. Electrical Work: Coordinate the plumbing work with electrical work, and properly interface with the electrical service. In general, and except as otherwise indicated, install plumbing equipment ready for electrical connection. Refer to electrical sections of the specifications for electrical connection of plumbing equipment.

D. Utility Connections: Coordinate the connection of plumbing systems with exterior underground utilities and services. Comply with the requirements of governing regulations, franchised service companies and controlling agencies. Provide a single connection for each service except where multiple connections are indicated.

END OF SECTION 22 02 10

SECTION 220220 - PLUMBING SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUBMITTAL FORMS AND PROCEDURES:

A. The purpose of submittals is to demonstrate to the Architect/Engineer that the Contractor understands the design concept. The Architect/Engineer's review of such drawings, schedules, or cuts shall not relieve the Contractor from responsibility for deviation from drawings or specifications unless he has, in writing, called the Architect/Engineer's attention to such deviations at the time of submission, and has received from the Architect/Engineer, in writing, permission for such deviations. All submittals must be completely checked by the Contractor prior to submission for review.

B. Hard Copy Submittals: Submittal data shall be placed in one or more hard-back 3-ring binders, arranged and labeled according to specification section. Each binder shall contain a title page and table of contents. Provide separator tabs, and label by specification section. Make note in the table of contents, any drawings that accompany the submittal. Title page shall contain Project Name, Contractor’s Name, Division 22 Superintendent’s name, Suppliers and point of contact for each, and date. Except as otherwise indicated in other sections, submit 5 complete copies. Quantity indicated does not include copies required for regulatory agencies.

C. Electronic Submittals: If the Architect agrees to allow electronic submittals via an on-line information management product such as “Submittal Exchange, etc., all electronic submittal files shall be organized to match the bid documents for specification section and name. Each submittal file shall be complete for each specification section. Multiple partial submittals per specification section will be rejected. Make note in the table of contents, any drawings that accompany the submittal. Title page shall contain Project Name, Contractor’s Name, Division 22 Superintendent’s name, Suppliers and point of contact for each, and date.

D. Submittals shall be made for all items contained in the following specification sections:

1. Plumbing Coordination
2. Plumbing Identification
3. Plumbing Pipe, Tube, and Fittings
4. Plumbing Hangers and Supports
5. Plumbing Vibration and Seismic Control
6. Plumbing Piping Systems Insulation
7. Gas Piping System
8. Domestic Water Piping System
9. Soil, Waste and Vent Piping System
10. Water Heaters

11. Plumbing Fixtures
12. Electric Water Coolers

E. Response to Submittals: A Submittal Review Report shall be issued by the Architect/Engineer with the following classifications for each item:

1. "No Exceptions Taken": No corrections, no marks. Contractor shall submit copies for distribution.
2. "Make Corrections Noted": A few minor corrections. Items may be ordered as marked up without further resubmission. Submit copies for distribution.
3. "Revise and Resubmit": Minor corrections. Item may be ordered at the Contractor's option. Contractor shall resubmit drawings with corrections noted.
4. "Rejected": Major corrections or not in accordance with the contract documents. No items shall be ordered. Contractor shall correct and resubmit drawings.

PART 2 - PRODUCTS

2.1 SUBMITTAL REQUIREMENTS:

A. General: Each specification section shall list the required submittal items. All submittal items shall conform to the requirements listed below. For each major section of submittal data, include a summary page which lists items and model numbers for each piece of equipment.

B. Shop Drawings: Prepare shop drawings to accurate scale except where diagrammatic representations are specifically indicated. Show clearance dimensions of critical locations, and show dimensions of spaces required for operation and maintenance of equipment. Show piping connections and other service connections, and show interface with other work including structural support. Indicate by note, the portions of plumbing work shown on the shop drawings which deviated from the indication of work in the contract documents, and explain the reasons for the deviations. Show how such deviations coordinate with interfacing deviations on shop drawings for other portions of the work, currently or previously submitted.

C. Manufacturer's Data: Where pre-printed data is submitted for more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy with black pen to indicate which of the variations is to be provided. Delete or mark-out significant portions of preprinted data which are not applicable. Where operating ranges are shown, mark data to show portion of range required for project application. Expansion or elaboration of standard data to describe a non-standard product must be processed as a shop drawing submittal. For each product include the manufacturer's production specifications, installation or fabrication instructions, nearest source of supply (including telephone number), sizes, weights, speeds, operating capacities, piping and service line connection sizes and locations, statements of compliance with required standards and governing regulation (include manufacturer's signed statements if not covered in printed data), performance data (where applicable) and similar information needed to confirm compliance with the requirements.

D. Certifications: Where specifically indicated, submit with notarized execution.

E. Test Reports: Submit test reports which have been signed and dated by the firm performing

the test and prepared in the manner specified in the standard or regulation governing the test procedures as indicated.

F. Manufacturer's Product Warranties: Where pre-printed and published warranty includes substantial deviation from required warranty (as judged by the Architect or Engineer), product is automatically disqualified from use on the project, except where manufacturer prepares and issues a specific product warranty on the product, stating that it is in lieu of the published warranty, and is executed by an authorized officer, and complies with the requirements. Warranties shall comply with the requirements of individual specification section where those requirements exceed the manufacturer's standard warranty.

PART 3 - EXECUTION

3.1 CLOSEOUT REQUIREMENTS:

A. Operating Instructions: Submit manufacturer's operating instructions for each item of plumbing equipment and supplement with additional project application instructions where necessary. Prepare and submit specific operating instructions for charging, start-up, control or sequencing of operation, phase or seasonal variations, shut-down, safety and similar operational instructions. Prepare in typewritten form in completely explained and easily understood English language.

B. Maintenance Manuals: Organize each copy of the required system maintenance manuals to include an index followed by thumb-tab marked sections for each of the following:

1. System operating instructions.
2. Emergency instructions including addresses and telephone numbers of service sources.
3. Regular system maintenance procedures including lubrication.
4. Spare parts listing and stocking recommendations.
5. Inspection, adjusting, rebalancing, cleaning, parts replacement, and similar maintenance instructions and recommendations, including the proper use of tools and accessories.
6. Valve schedule and control diagram for each system.
7. Manufacturer's data for each operating item in each system.
8. Manufacturer's product warranties and guarantees relating to the system and equipment items in the system.
9. Corrected or approved issues of submittal items relating to the system.
10. Bind each maintenance manual in one or more vinyl-covered, 2", 3-ring binder, plus pocket-folder type binders for folded drawings, and mark the back spine of each binder with system identification and volume number.

C. Maintenance Materials: Deliver to Owner’s representative at the location as directed, in containers or packages suitable for storage and fully identified.

D. Guarantees: Where indicated as "Certified", provide guarantee which, in addition to execution by an authorized officer of each guarantor, is attested to by the Secretary of each guarantor and bears the corporate seal.

END OF SECTION 220220

SECTION 22 02 30 - PLUMBING IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:

A. Manufacturers: Firms regularly engaged in the manufacture of identification systems required for this product.

B. Submittals: Submit manufacturer's data on materials and submit a sample of each type required.

PART 2 - PRODUCTS

2.1 PLUMBING IDENTIFICATION MATERIALS:

A. Plastic Pipe Markers:

1. General: Product manufacturer's standard pre-printed, flexible or semi-rigid, permanent, color-coded, plastic-sheet pipe markers, complying with ANSI A13.1.
2. Small Pipe: For external diameters less than 6 inches (including insulation, if any), provide full band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
   a. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
   b. Adhesive lap joint in pipe marker overlap.
   c. Laminated or bonded application of pipe marker to pipe (or insulation).
   d. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4 inch wide; full circle at both ends of pipe marker, tape lapped 1-1/2 inch.
3. Large Pipes: For external diameters of 6 inches and larger (including insulation, if any), provide either full-band or strip-type pipe markers, but not narrower than 3 x letter height (and of required length), fastened by one of the following methods:
   a. Laminated or bonded application of pipe marker to pipe (insulation).
   b. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2 inches wide: full circle at both ends of pipe marker, tape lapped 3 inches.
4. Lettering: Comply with piping system names as specified, scheduled or shown, and abbreviate only as necessary for each application length.
5. Arrows: Print each pipe marker with arrow indicating direction of flow, either integrally with piping system service lettering or as separate unit of plastic (to accommodate both directions).
6. Install pipe markers on piping of the following piping systems:

Domestic Cold Water
Domestic Hot Water
Dom. Hot Water Return
Natural GAs
Compressed Air

B. Plastic Tape: Manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick:

1. Width: Provide 1-1/2 inches wide tape markers on pipes with outside diameters including insulation of less than 6 inches, 2-1/2 inches wide tape on larger pipes.
2. Color: Comply with ANSI A13.1.

C. Engraved Plastic-Laminate Signs:

1. General: Provide engraving stock melamine plastic laminated, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core, letter color, except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
2. Thickness: 1/16 inch, except as otherwise indicated.
3. Fasteners: Self-tapping stainless steel screws, except contact type permanent adhesive where screws cannot or should not penetrate the substrate.

D. Valve Tags:

1. Valve tags shall be 18 gauge (minimum) brass with 1-1/4" (minimum) height and width. Identification letters and numbers shall be stamped in tag and shall be filled with black paint
2. Valve tags shall be attached to valve using cable ties. Cable ties shall be self-locking nylon ties.
3. Valve tags shall be installed at all shut-off, balancing, metering, and drain valves. Valve tag shape and designations shall be as follows:

Identification System	Shape	Numbers
Domestic Cold Water	Hexagonal	CW-1, 2, 3, ...
Domestic Hot Water	Hexagonal	HW-1, 2, 3, ...
Dom. Hot Water Return	Hexagonal	HWR-1, 2, 3, ...
Natural Gas	Octagonal	NG-1, 2, 3, ...
Compressed Air	Octagonal	CA-1, 2, 3, ...

E. Valve Charts:

1. Valve charts shall be provided for plumbing systems. Charts shall be located in the main WH/Pump room.
2. Valve charts shall be typed listing all valve tags. List shall include identification number, valve location in system (e.g., Corridor 123, Water Heater WH-1, etc.) and its function (e.g., shut-off, balancing, drain, etc.). Charts shall be mounted in a wooden frame with glass cover.

2.2 LETTERING AND GRAPHICS:

A. General: Coordinate names, abbreviations and other designations used in the identification work, with the corresponding designations shown, specified or scheduled. Provide numbers, lettering recommended by manufacturers or as required for proper identifications and operation/maintenance of the systems and equipment.

B. Multiple Systems: Where multiple systems of the same generic name are shown and specified, provide identification which indicates the individual system number as well as the service.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION:

A. Coordination: Where identification is to be applied to surfaces which require insulation, painting and other covering or finish, including valve tags in finished spaces, install identification after completion of covering or painting.

B. All equipment, valves, etc. located above ceiling grids shall be located with an engraved marker permanently attached to the ceiling grid. The marker shall describe the item located above the ceiling.

C. Piping System Identification:

1. General: Install pipe markers on each system indicated to receive identification, and include arrows to show normal direction of flow.

D. Locate pipe markers as follows wherever piping is exposed to view in mechanical rooms, accessible maintenance spaces (including accessible areas above ceilings) and exterior non-concealed locations:

1. Near each valve and control device.
2. Near each branch, excluding short take-offs for fixtures. Mark each pipe at branch, where there could be a question of flow pattern.
3. Near locations where pipes pass through walls or ceilings, or enter non-accessible enclosures.
4. Near major equipment items and other points of origination and termination.
5. Spaced intermediately at maximum spacing of 50 feet along each piping run, except reduce spacing to 25 feet in congested areas of piping and equipment.

E. Do not mark piping exposed in finished occupied spaces.

F. Plumbing Equipment Identification: Install an engraved plastic laminate sign on or near each major item of plumbing equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for all major items of plumbing equipment.

G. Valve tags shall be attached to the valve handwheel with cable ties.

END OF SECTION 22 02 30

SECTION 22 02 40 - PLUMBING WORK CLOSEOUT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DOCUMENTATION PROCEDURES:

A. Signed Commitments: Do not proceed with transfer of plumbing systems to the Owner for operation until warranties, performance certifications and similar commitments to be signed by Contractor and other entities have been executed and transmitted to Architect (for Owner's records).

1.3 RECORD DRAWINGS:

A. Explanation: Except where otherwise indicated, plumbing drawings (contract drawings) prepared by Architect/Engineer, contract/drawings, are diagrammatic in nature and may not show locations accurately for various components of plumbing systems. Shop drawings, including coordination drawings, prepared by Contractor shall show certain portions of work more accurately to scale and location, and in greater detail.

B. General Recording Procedure: Maintain a white-print set, blue-line or black-line, of plumbing contract drawings and shop drawings in clean, undamaged condition, for mark-up of actual installations which vary substantially from the work as shown. Mark-up whatever drawings are most capable of showing the installed conditions accurately; however, where shop drawings are marked, record a reference note on appropriate contract drawing. Mark with erasable pencil and use multiple colors to aid in the distinction between work of separate systems. In general, record every substantive installation of plumbing work which previously is either not shown or shown inaccurately, but in any case record the following:

1. Underground and aboveground piping, both exterior and interior, drawn to scale and fully dimensioned.
2. Plumbing "Project Record" shall be maintained as part of the "Project Record" specified in Division 1.

PART 2 – PRODUCTS (Not applicable)

PART 3 - EXECUTION

3.1 CLOSEOUT PROCEDURES:

A. General Coordination: Sequence closeout procedures properly, so that work will not be endangered or damaged, and so that every required performance will be fully tested and demonstrated.

B. System Performance Test Run: At the time of plumbing work closeout, check each item in each system to determine that it is set for proper operation. With Owner's representative and Architect/Engineer present, operate each system in a test run of appropriate duration to demonstrate compliance with performance requirements. During or following test runs, make final corrections or adjustments of system to refine and improve performances wherever possible, including noise and vibration reductions, elimination of hazards, better response of controls, signals and alarms, and similar system performance improvements. Provide testing or inspection devices as may be requested for Architect's/Engineer's observation of actual system performances. Demonstrate that controls and items requiring service or maintenance are accessible. Test run shall be scheduled to coincide with Engineer's final inspection of the plumbing work.

C. Cleaning and Lubrication: After final performance test run of each plumbing system, clean system both externally and internally. Flush piping system by operating drains and similar means, and clean strainers and traps. Lubricate both power and hand operated equipment and remove excess lubrication. Touch-up minor damage to factory painted finishes and other painting specified as plumbing work; refinish work where damage is extensive.

D. General Operating Instructions: In addition to specified training of Owner's operating personnel specified in individual plumbing sections, and in addition to preparation of written operating instructions and compiled maintenance manuals specified, provide general operating instructions for the plumbing systems. Conduct a walk-through explanation and demonstration for orientation and education of Owner's personnel to be involved in continued operation of building.

1. Describe each basic system and how its control system functions, including flow adjustments, temperature control and similar operations.
2. Explain and point out identification system, displayed diagrams, signals, alarms and similar provisions of the work.
3. Describe basic sequencing requirements and interlock provisions for system start-up, phasing and shut-down.
4. Emphasize emergency procedures and safety provisions for protection of equipment and safety of occupants during equipment malfunction, disasters, power failures and similar unusual circumstances.
5. Outline basic maintenance procedures.

E. Demonstrate what adjustments have been made and can continue to be made to reduce noise and vibration, improve system output, decrease energy consumption and similar performance improvements.

F. Point out operational security provisions, safety, unavoidable hazards and similar operator limitations. Display and conduct a "thumb-through" explanation of maintenance manuals, record drawings, meter readings and similar service items.

G. Construction Equipment: After completion of performance testing and Owner's operating instructions and demonstrations, remove installers tools, test facilities, construction equipment and similar devices and materials used in execution of the work but not

incorporated in the work.

3.2 CONTINUED SYSTEM OPERATIONS:

A. Final Acceptance: At time of substantial completion of plumbing work, Owner's operating personnel will take over operation of plumbing systems. However, until time of final acceptance, respond promptly with consultation and services on whatever operation or maintenance problems may remain or arise.

END OF SECTION 22 02 40

SECTION 22 03 10 – PLUMBING PIPE, TUBE AND FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:

A. Industry Standards:

1. Qualify welding procedures, welders and operators in accordance with ASME B31.1 for shop and project site welding of piping work.
2. Certify welding of piping work using the Standard Procedure Specifications by, and welders tested under supervision of, the National Certified Pipe Welding Bureau.
3. Where plastic piping is indicated to transport potable water, provide pipe and fittings bearing approval label by the National Sanitation Foundation (NSF).

B. SUBMITTALS:

1. Submit manufacturer's data, welding certifications, test reports, and product warranties as applicable for all piping materials.
2. Grooved joint couplings and fittings shall be shown on drawings and product submittals, and be specifically identified with the applicable style number.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS:

A. General: Provide pipe and tube of the type, joint type, grade, size and weight (wall thickness or Class) indicated for each service. Where type, grade or class is not indicated, provide proper selection as determined by Installer for installation requirements and comply with governing regulations and industry standards.

B. Black Steel Pipe: ASTM A 53, Schedule 40.

C. Galvanized Steel Pipe: ASTM A 53, Schedule 40.

D. Stainless Steel Pipe: ASTM A 312, Schedule 5S, full finish annealed pipe, certified for use with mechanical fittings.

E. Copper Tube: ASTM B88-89 Type (wall thickness) as indicated for each service; hard-drawn temper, except as otherwise indicated. Solder for use on domestic water piping shall be lead free type.

F. Copper Tube DWV: ASTM B 306-88 type.

G. Hubless Cast-Iron Soil Pipe: CISPI 301 or ASTM A 888 including standards for heavy duty coupling assembly ASTM C 564 and ASTM C 1540. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and be listed by NSF.

H. Cast-Iron Hub-and-Spigot Soil Pipe: ASTM A 74 including ASTM C 564 and ASTM C1563 for compression gaskets. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and be listed by NSF International.

I. Plastic Pipe:

1. PVC-DWV: ASTM D2665-88
2. ABS-DWV: ASTM D2661-87

J. Plastic Pipe - Natural Gas Service:

1. Polyethylene: ASTM D2513

K. Fiberglass Reinforced Pipe:

1. ASTM D2996 with threaded and bonded joints.

2.2 PIPE/TUBE FITTINGS:

A. General: Provide factory-fabricated fittings of the type, materials, grade, class and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube valve or equipment connections in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections, and with pipe manufacturer's recommendations where applicable.

B. Cast-Iron Threaded Fittings for Steel Pipe: ASTM A 126-84 Class 125, plain or galvanized to match pipe.

C. Welded Fittings for Steel Pipe: ASTM A234.

D. Cast-Iron Flanged Fittings for Steel Pipe: ASME B16.1, including bolting. Class 125, plain or galvanized to match pipe.

E. Gaskets for Flanged Joints: ASME B16.21; full-faced for cast-iron flanges.

F. Gaskets for Hub and Spigot Pipe and Hubless Couplings: ASTM C 564, and ASTM C 1540 for heavy duty couplings, ASTM C 1563 for compression gaskets, and CISPI 310 or ASTM C 1277 for standard duty couplings.

G. Soldering Materials: Except as otherwise indicated, provide soldering materials as determined by the Installer to comply with installation requirements.

1. Tin-Antimony Solder: ASTM B 32, Grade 95TA.

H. Mechanical Couplings for IPS Pipe: Coupling housings shall be ductile iron (ASTM A536). Bolts and nuts shall be carbon steel track-type (ASTM A183), minimum tensile 110,000 psi. Gaskets shall be Grade "E" EPDM, for water services from -30 to +230EF. At joints allowing controlled movement, expansion, contraction of deflection, flexible couplings with shall be used. At all joints not requiring flexibility, a rigid coupling shall be used. Fittings for pipe 2 inches and smaller shall be the mechanical compression type. Mechanical couplings shall be by Victaulic, Anvil or Grinnell.

1. Rigid Type: Coupling housings cast with offsetting, angle-pattern bolt pads shall be used to provide system rigidity and support and hanging in accordance with ANSI B31.1 and B31.9.
2. Flexible Type: Use in locations where vibration attenuation and stress relief are required.
3. Flange Adapter: Flat face, for direct connection to ANSI Class 125 or 150 flanged components.

I. Grooved End Fittings for Steel Pipe: Fittings shall be ductile iron (ASTM A536) forged steel (ASTM A234); or fabricated from carbon steel pipe (ASTM A53); with pre-grooved ends for use with mechanical couplings of the same manufacturer.

J. Mechanical Couplings for Hard Copper Tube: Coupling housings shall be ductile iron (ASTM A536), coated with copper colored alkyd enamel and cast with angle-pattern bolt pads for system rigidity. Bolts and nuts shall be carbon steel track-type (ASTM A183), minimum tensile 110,000 psi. Gaskets shall be Grade "E" EPDM FlushSeal® type, for water services from -30 to +230EF. Mechanical couplings shall be by Victaulic, Anvil or Grinnell.

K. Mechanical Couplings for Copper Pipe: Fittings 2"-4" size shall be wrought copper (ASTM B75 C12200 or ASTM B152 C11000 and ANSI B 16.22). Fittings 5" - 8" size shall be bronze sand casting (ASTM B584-87) or copper alloy CDA844 (81-3-7-9) (ANSI B 16.18). Fittings shall have pre-grooved ends for use with mechanical couplings of the same manufacturer. Fittings shall be manufactured to copper tubing sizes. (Flaring of tube and fitting ends to IPS dimensions is not allowed.)

L. Copper Press-Connect Fittings: Fittings 2" and smaller size shall be cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end. Fittings 2½"-4" size shall be wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

M. Solvent Cement for PVC Joints: D2564-88.

N. Solvent Cement for ABS Joints: D2235-88.

O. Fusion Welding for Polypropylene Joints: Socket-fusion, elecrofushion, or butt-fusion, as applicable, in accordance with ASTM F 2389 and the manufacturer's specifications.

P. Pipe Sleeves:

1. Iron Pipe Sleeves: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.
2. Sheet Metal Pipe Sleeves: Fabricate from galvanized sheet metal closed with lock-seam joints. For following pipe sizes provide gauge indicated: 3 inch pipe and smaller, 20 gauge; 4 to 6 inch pipe, 16 gauge; over 6 inch pipe, 14 gauge.
3. Pipe Sleeve Caulking: 3M Fire Barrier Caulk, CP25N/S, except where another caulking

system or material is specified or approved by Jaco or Flamestopper.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. General: Install pipe, tube and fittings in accordance with recognized industry practices which will achieve permanently-leakproof piping systems, capable of performing each indicated service without piping failure. Install each run with a minimum of joints and couplings, but with adequate and accessible unions for disassembly and maintenance/ replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections, within 1/16" misalignment tolerance.

1. Comply with ASME B31.1 Code for Pressure Piping.

B. Locate piping runs as indicated on the drawings. Route vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown, or described by diagrams, details and notations or, if not otherwise indicated, run piping in the shortest route which does not obstruct usable space or block access for servicing the building and its equipment. Where possible, locate insulated piping for 1.0" clearance outside insulation. Changes in direction shall be made with fittings.

C. Piping System Joints: Provide joints of the type indicated in each piping system.

D. Threaded Joints: Thread pipe in accordance with ANSI B2.12; cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed.

E. Welded Joints: Weld pipe joints in accordance with recognized industry practice and as follows: Weld pipe joints only when ambient temperature is above 0 degrees F. where possible. Bevel pipe ends at a 37.5 degree angle where possible, smooth rough cuts and clean to remove slag, metal particles and dirt. Install welding rings for butt welded joints. Use pipe clamps or tack-weld joints with 1.0" long welds; 4 welds for pipe sizes to 10". Build up welds with a stringer-bead pass, followed by a hot pass, followed by a cover or filler pass. Eliminate valleys at center and edges of each weld. Weld by procedures which will ensure elimination of unsound or unfused metal, cracks, oxidation, blow holes and non-metallic inclusions. Do not weld-out piping system imperfections by tack-welding procedures; refabricate to comply with requirements. Install forged branch-connection fittings wherever branch pipe is indicated, or install regular "T" fitting (at Contractor's option).

F. Flanged Joints: Match flanges within piping system, and at connections with valves and equipment. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets.

G. Mechanical Coupling Joints: Square cut pipe ends and deburr. Roll-groove pipe ends to manufacturer’s specifications. Lubricate gaskets completely on interior and exterior using a

non-petroleum based lubricant. Slide gasket over pipe ends between grooves. Engage coupling housing into grooves and tighten until housing bolt pads are in full contact on each side of joint. For pipes 2 inches and smaller, no groove is required. Mark pipe ends for proper insertion into couplings and fittings. Engage piping into fitting to full depth, indicated by marked pipe ends. Align pipe ends, position compression tool and press trigger until assembly cycle is complete. All grooved couplings, fittings, valves and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be molded and produced by the grooved coupling manufacturer. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Grooved coupling manufacturer's factory trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools, application of groove and installation of grooved piping products. Factory trained representative shall periodically inspect the product installation. Contractor shall remove and replace any improperly installed products.

H. Soldered Joints: Solder copper tube and fitting joints where required, in accordance with recognized industry practice. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings with steel wool. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens. Use a non-corrosive paste flux and wire solder composed of 95 percent tin and 5 percent antimony.

I. Fusion Welding for Polypropylene Joints: Joint preparation, setting and alignment, fusion process, cooling times and working pressure shall be in accordance with the pipe and fitting manufacturer's specifications.

J. Hubless Cast-Iron Joints: Comply with the manufacturer's installation instructions, CISPI 310 and local code requirements.

K. Plastic Pipe/Tube Joints: Comply with manufacturer's instructions and recommendations and with applicable industry standards. Install all storm, soil, waste and vent plastic pipe underground in compliance with ASTM D 2321.

L. Insulating (Dielectric) Nipples: Comply with manufacturer's instructions for installing nipples in a manner which will prevent galvanic action and stop corrosion where the joining of ferrous and non-ferrous piping occurs.

M. Pipe Sleeves: Install pipe sleeves of the types specified wherever piping passes through the walls, floors or structural members of the work. Provide sleeves of adequate size, accurately centered in pipe runs. Size sleeves so that piping and insulation will have free movement in the sleeve, including allowance for thermal expansion. Where insulation includes a vapor barrier covering provide sleeve with sufficient clearance for installation of vapor barrier. Install length of sleeve equal to thickness of construction penetrated, except extend floor sleeves 0.25 inches above floor finish. Provide temporary support of sleeves during placement of concrete and other work around sleeves and provide temporary closure to prevent concrete and other materials from entering pipe sleeves.

1. Sleeve Type: At interior partitions and ceilings, install sheet metal sleeves.

2. Sleeve Type: At exterior penetrations both above and below grade, install iron pipe sleeves.
3. Sleeve Type: Except as otherwise specified, install steel pipe sleeves.
4. Caulk pipe sleeves at exterior penetrations and at other locations where indicated. Provide sufficient quantities of oakum and lead to make permanent weather-tight closure between sleeve and piping, slightly recessed at exposed surface.

N. PVC piping exposed to sunlight shall be coated with water-based latex white paint to prevent UV light degradation.

3.2 CLEANING, FLUSHING AND INSPECTING:

A. General: Clean exterior surfaces of installed piping systems of superfluous materials and prepare for application of specified coatings.

B. Flush out piping system with clean water before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items.

3.3 PIPING TESTS:

A. General: Provide temporary equipment for testing, including pump and gages. Test piping systems before insulation is installed wherever feasible, and remove control devices before testing. Test each natural section of each piping system independently, but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating.

1. Required test period is 2 hours.

B. Unless otherwise specified for specific systems, hydraulically test each pressurized piping system at 150% of operating pressure indicated, but not less than 100 psig test pressure.

C. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 5% of test pressure.

D. Repair piping systems sections which fail the required piping test, by disassembly and re-installation, using new materials to the extent required to overcome leakage. Do not use chemicals, stop-leak compound, mastics, or other temporary repair methods. Drain test water from piping systems after repair work and retesting has been completed.

END OF SECTION 22 03 10

SECTION 22 03 20 – PLUMBING HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUBMITTALS:

A. Provide manufacturer's data, test reports, and product warranties on all items.

PART 2 - PRODUCTS

2.1 HANGERS AND SUPPORTS:

A. General: Except as otherwise indicated, provide factory-fabricated piping hangers and supports of the type specified complete with bolts and washers. Comply with the manufacturer's published product information. Size hangers and supports properly for piping and weight of the medium being transported. Provide insulation shields for all insulated piping.

B. Hangers for domestic hot and cold water piping shall be copper plated band type with adjusting nut; Grinnell, Fig. CT-69, B-Line Fig. B 3172CT, or equivalent by Michigan Hanger, PHD Manufacturing or Hubbard Enterprises/Holdrite.

C. Hangers for cast iron or plastic drain and vent piping, compressed air piping, and natural gas piping shall be Clevis type, B-Line Fig. B 3100, or equivalent by Grinnell, Michigan Hanger, PHD Manufacturing or Hubbard Enterprises/Holdrite.

D. Special Hangers: Special hangers and attachments shall be as detailed or indicated on the drawings.

PART 3 - EXECUTION

3.1 HORIZONTAL PIPING SUPPORT:

A. Maximum spacing of hangers and supports for above-ground horizontal pipe and tubing shall be as follows:

1. Cast-iron pipe (all sizes) shall be supported at not more than five foot intervals and near each hub or hubless pipe joint and at multiple fittings as required.

B. Steel Pipe:

Nominal Pipe Size (inches)	Support Spacing (feet)
1-1/4 & smaller	7
1-1/2	9
2	10
2-1/2	11
3 & larger	12

C. Copper Tubing:

Tubing Size (inches)	Support Spacing (feet)
3/4 & smaller	5
1 to 2-1/2	6
3	10
4 and larger	12

D. Plastic Pipe:

Nominal Pipe Size (inches)	Support Spacing (feet)
3/4	3.0
3/4 to 1	3.5
1-1/4 to 1-1/2	4.0
2 to 2-1/2	4.5
3 and larger	5.5

E. Prevent electrolysis in the support of copper tubing by the use of hangers and supports which are copper plated, or by other recognized industry methods.

F. Branch piping located in walls, partitions or pipe chases shall be rigidly supported inside the wall or chase.

G. Piping installed above a roof shall be supported on pre-fabricated, non-penetrating supports by *Pipe Pier* or approved equal. Provide matching adjustable elevation kits.

3.2 VERTICAL PIPING SUPPORT:

A. Cast Iron Pipe: Support at each floor and support at each base and roof level with pipe clamps.

B. Plastic Piping: Support at 8 feet maximum intervals and near each joint.

C. Copper Tubing: Support at riser tops and 5 feet maximum on center for pipe 1-1/2” and larger and 4 feet on center for pipe 1-1/4” and smaller. Use copper plated pipe clamps.

D. Steel Pipe: Supports at top and bottom of riser and on 10 feet maximum centers.

E. Fixture Supports: See Fixture Schedule. Provide concealed supports and carriers recommended by the manufacturer of the fixtures and equipment to suit the structural and finish conditions.

3.3 ADJUSTMENT OF HANGERS AND SUPPORTS:

A. Adjust hangers and supports to bring piping to proper level, elevations and slopes.

END OF SECTION 22 03 20

SECTION 22 03 30 – PLUMBING EXCAVATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:

A. Coordination: Where excavation and backfill for plumbing work passes through or occurs in the same areas as work specified in the Division 2 sections, comply with both the requirements of the Division 2 sections and the requirements of this section, whichever is the more stringent (as determined by the Architect/Engineer in cases of conflicting requirements).

1.3 JOB CONDITIONS:

A. Existing Utilities: Locate and protect existing utilities and other underground work in a manner which will ensure that no damage or service interruption will result from excavating and backfilling.

PART 2 - PRODUCTS

2.1 BACKFILL MATERIALS:

A. Subbase Material: A graded mixture of gravel, sand, crushed stone or crushed slag.

PART 3 - EXECUTION

3.1 EXCAVATING:

A. Inspection: The excavator must examine the areas to be excavated, and the conditions under which the work is to be performed, and notify the Contractor in writing of conditions detrimental to the proper completion of the work. Do not proceed with excavating until unsatisfactory conditions have been corrected in a manner acceptable to the excavator.

B. General:

1. Do not excavate until the work is ready to proceed without delay, so that the total time lapse from excavation to completion of backfilling will be minimum.
2. Provide signs, illuminations and barricades as necessary to prevent accidents at

excavations.

3. Excavate with vertical sided excavations to the greatest extent possible, except where otherwise indicated. Where necessary, provide sheeting and cross-bracing to sustain sides of excavations. Remove sheeting and cross-bracing during backfilling wherever such removal would not endanger the work or other property. Where not removed, cut sheeting off at a sufficient distance below finished grade to not interfere with other work.
4. Excavate for piping with 6" to 9" clearance both sides of pipe, except where otherwise shown or required for proper installation of pipe joints, fittings, valves and other work. Provide a minimum of 12" clearance around underground tanks.
5. For work to be supported directly on undisturbed soil, do not excavate beyond required depths, and hand excavate the bottom cut to accurate elevations. Except as otherwise indicated, support the following work on undisturbed soil at the bottom of the excavations:
   a. Piping of 5" and less pipe/tube size.
   b. Cast-in-place concrete.
6. Where directed, excavate additional depth to reach satisfactory soil-bearing conditions. Backfill with subbase material, compacted as directed, to indicated excavation depth.
7. Except as otherwise indicated, excavate for exterior water-bearing piping so that the top of piping will not be less than 2'- 0" vertical distance below finished grade.
8. Store excavated material (temporarily) near the excavation, in a manner which will not interfere with or damage the excavation or other work.
   a. Retain excavated material which complies with the requirements for backfill material.
   b. Dispose of excavated material which is either in excess of quantity needed for backfilling or does not comply with requirement for backfill material.

3.2 DEWATERING:

A. Maintain dry excavations by removing water. Pump minor inflow of ground water from excavations; protect excavations from major inflow of ground water by installing temporary sheeting and waterproofing. Provide adequate barriers which will protect other excavations from being damaged by water, sediment or erosion from or through excavations.

3.3 BASE PREPARATION:

A. Install subbase material to receive plumbing work, and compact by tamping to form a firm base for the work. For piping, shape the subbase to fit the shape of the bottom 90 degrees of the cylinder, for uniform continuous support.

B. Shape subbases and bottoms of excavations with recesses to receive pipe bells, flanges connections, valves and similar enlargements in the piping systems.

3.4 BACKFILLING:

A. Do not backfill until installed work has been tested and accepted, wherever testing is indicated.

B. Condition backfill material by either drying or adding water uniformly, to whatever extent

may be necessary to facilitate compaction to the required densities. Do not backfill with frozen soil materials.

C. Backfill simultaneously on opposite sides of work, and compact simultaneously; do not dislocate the work from installed positions.

D. Backfill excavations in 8" high courses of backfill material, uniformly compacted to the following densities (percent of maximum density, ASTM Standard Proctor), using power-driven hand-operated compaction equipment.

1. Lawn/Landscaped Areas: 90%
2. Roadways: 95%
3. Paved Area, Other than Roadways: 95%

E. Backfill to elevations matching adjacent grades, at the time of backfilling excavations for mechanical work.

F. Where compaction tests indicate lower densities of backfill than specified, continue compaction (and re-excavation and backfilling where necessary) and provide additional testing as directed by the Architect/Engineer.

3.5 PERFORMANCE AND MAINTENANCE:

A. Where subsidence is measurable or observable at plumbing work excavations during the guarantee period, remove the surface (pavement, lawn or other finish), add backfill material, compact and replace the surface treatment. Restore the appearance, quality and condition of the surface or finish to match adjacent work, and eliminate evidence of the restoration to the greatest extent possible.

END OF SECTION 22 03 30

SECTION 22 11 10 - DOMESTIC WATER PIPING SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:

A. Code Compliance: Comply with governing regulations which require the products used for domestic water piping work to be selected from lists in certain published standards or codes as indicated therein.

1.3 SUBMITTALS:

A. Provide manufacturer's data, test reports, and product warranties as applicable for all items.

B. Provide certified copy of contractor’s sterilization test.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS:

A. General: Comply with section 22 0310 for product requirements of piping materials. For each service, provide the piping materials indicated including, pipe, fitting, hangers supports, anchors, valves and accessories. Where more than one type is indicated, selection is Installer's option. Where type is not otherwise indicated, provide materials complying with governing regulations.

B. Service Water Piping:

1. Pipe Sizes 4" and Smaller:	Copper tube of the size indicated.
2. Wall Thickness:	Type K
3. Fittings:	Wrought copper-solder joint (with lead free solder).

C. Water Distribution Piping:

1. Pipe Sizes 4" and Smaller:	Copper tube of the size indicated.
2. Wall Thickness:	Type K (belowground). Type L (above ground).
3. Fittings:	Wrought copper-solder joint (with lead free solder).

2.2 ACCESSORIES:

A. General: Provide factory-fabricated piping products of the size, type, rating and capacity indicated. Where not indicated, provide proper selection as determined by the Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections.

B. Watts is an approved manufacturer for water supply products.

C. Water Hammer Arrestors: Bellows type; precharged compressor chamber; stainless steel casing and bellows. Provide sizes complying with PDI Standard WH-201. Josam 75000 Series, Jay R. Smith Fig 5000, Watts SS series or Zurn 1700 Series.

D. Exterior Wall Hydrant HB/E: All brass freezeproof automatic draining type with polished brass finish, flush mounting wall box, adjustable packing nut, teflon impregnated packing, vacuum breaker with hose thread and loose key operated. Woodford Manufacturing Co. Model B67, Josam #71000, Watts HY-725 Series or Zurn Z-1300.

E. Interior Wall Hydrant HB/B: All brass with polished brass finish, flush mounting wall box, adjustable packing nut, teflon impregnated packing, vacuum breaker with hose thread and loose key operated. Woodford Manufacturing Co. Model B79, Josam #71020 Watts HY-330 or Zurn Z-1320.

F. Interior Hose Bibbs HB/I: Hose bibbs shall be ½ inch in size, polished chrome plated bronze body with integral vacuum breaker and handwheel operated. Interior Hose Bibbs shall be Woodford Model 26, Chicago No. 387, T&S Brass B-0730 or Acorn 8135.

G. Roof Hydrant HB/R: Exposed, non-freeze roof hydrant, with coated cast iron head and lift handle with lock option, bronze interior parts, galvanized steel casing, and bronze valve housing with drain port in housing. Complete with coated cast iron roof support sleeve with wide anchoring flange and clamp collar. Zurn Z-1388, Watts HY-900 or equal by Woodford Manufacturing Co. or Josam.

H. Domestic Water Piping Strainers: Strainers shall be a "Y" bronze body type with 20 mesh stainless steel screen, and threaded ends, rated for 250 psig wwp at 210 degrees F. Strainers for domestic water shall be Watts Model LF777 or equivalent by Wilkins, Keckley or Mueller.

I. Flow Control Valves: Valves for domestic hot water return shall have brass and stainless steel bodies, with integral ball valve, ground joint union, and solder ends. Valve shall be rated for 600 psig and flow rate, as shown on drawings. Flow control valves shall be Autoflow Model FU-050, Hays 2500 or equivalent by Griswold.

J. Pressure Reducing Valves: Valves shall be bronze body construction with renewable seats and integral check valve and strainer. Pressure reducing valves shall be by Watts LF223, Bell & Gossett, Taco, Amtrol, or Armstrong.

K. Pressure Relief Valves: Valves shall be bronze construction engineered in accordance with the requirements of Section IV of the ASME Boiler and Pressure Vessel Code for Heating Boilers. Capacities shall be certified by the National Board of Boiler and Pressure Vessel Inspectors. Valves shall be by Bell & Gossett, Taco, Watts, or Armstrong.

L. Gate Valves: Valves 3 inches and smaller shall be all bronze, meeting MSS-SP80, inserted bonnet, solid wedge, non-rising stem type and rated at 125 SWP, 200 WOG. Handles shall be malleable iron with bronze stem. Valves shall be by Milwaukee, Nibco, Watts or Red-White.

M. Globe Valves: Valves 3 inches and smaller shall be all bronze, meeting MSS-SP80, inserted bonnet with integral seat and renewable disc. Valves shall be rated at 125 SWP, 200 WOG. Handles shall be malleable iron with bronze stem. Valves shall be by Watts, Milwaukee, Nibco, Watts or Red-White.

N. Check Valves: Valves 2 inches and smaller shall be bronze body with bronze seat and disc and shall be rated at 125 SWP, 200 W0G. Valves shall be by Milwaukee, Nibco, Watts or Red-White.

O. Ball Valves: Ball valves may be substituted for gate valves at the contractor's option. Ball valves shall have two-piece bronze or brass body, meeting MSS-SP110, full or standard port, blowout-proof stem and adjustable packing nut independent of handle. Valves shall be rated for 150 SWP, 600 WOG or 300 CWP. Valves shall be by Apollo, Milwaukee, Nibco, Victaulic, Watts Smith-Cooper or Red-White.

P. Thermometers: Piping systems thermometers shall be the red-reading mercury filled adjustable angle type. Thermometers shall be adjustable to any angle through a 180 degree arc and shall be provided with a locking device. Where possible, thermometers shall be installed not higher than 8 feet above finished floor. Final positioning of each thermometer shall be such that it is readable from the floor and it shall be locked in that position. Thermometers shall have V-cast aluminum case with baked enamel finish and 9 inch scale. Thermometers shall be provided with separable sockets, and where installed on insulated pipes, sockets shall be extension neck type. Thermometer scale range shall be 30 to 300 degrees F for hot water systems. Thermometers shall be by Wika, Trerice, Winters or Weiss.

Q. Pressure Gauges: Gauges shall be connected to the piping system with threaded chrome-plated brass pipe and fittings. Gauges shall be the flangeless type and shall have 4-1/2 inch dials, cast aluminum cases, stainless steel heavy duty rotary gear movements, phosphor bronze bourdon tubes, forged brass rod sockets and tips, 1/2% accuracy of scale range, plexiglass dial covers, and 1/4 inch lower connections. Each gauge shall be provided with chrome plated brass lever handle cock and a stainless steel pulsation dampener. Provide compound gauges for locations which under negative pressure. Range for pressure gauges shall be selected so that the normal operating point for each application falls in the approximate midpoint of the gauge range. Gauges shall be by Wika, Trerice, Winters or Weiss.

R. Access Panel: Access panels shall be 16 gauge steel door and frame with concealed hinge and vandal resistant latch. Panels shall be flush type. Access panel shall be by J. R. Smith, Watts, Zurn, Josam or Mifab.

S. Escutcheon Plates: Metal split-ring type units, with nickel or chrome plated finish. Provide units sized to fit closely outside of pipe insulation or bare pipe where no covering is required.

T. Automatic Air Vents: Provide automatic float type air vents in locations indicated on the drawings. Units shall be suitable for a maximum working pressure of 75 psig and a

maximum operating temperature of 240 degrees F. Automatic air vents shall be as manufactured by Taco, Bell & Gossett, Amtrol, Wheatley or Armstrong.

U. Manual Air Vents: Vents shall consist of a 1/4 inch gauge cock with softdrawn copper discharge tube.

V. Sheet-Metal Pipe Sleeves: Fabricate from galvanized sheet metal closed with lock-seam joints. For following pipe sizes provide gauge indicated: 3 inch pipe and smaller, 20 gauge; 4 inch to 6 inch pipe, 16 gauge; over 6 inch pipe, 14 gauge.

W. Pipe Sleeve Caulking: 3M Fire Barrier Caulk, CP25N/S, except where another caulking system or material is specified, or equivalent by Hilti or Tremco.

X. Hose Reels: Provide hose reel with all steel construction with support of axel shaft on both sides of reel, permanently lubricated bearings for positive recoil and long life, extra-large audible rachet lock so user knows when hose is locked, and multi-position roller guide for superior service in any position. Hose reel shall have a ½" inlet and 50 foot hose length. Hose reel shall be Graco 500 Series or equal by Lincoln, T&S Brass or Alemit.

2.3 DOMESTIC WATER BOOSTER SYSTEM:

A. Booster system shall be a duplex system for the K-12 building and single pump system for the media and fieldhouse buildings. Water booster systems shall be complete with pumps, motors, pressure regulating valves and control panel. The systems shall be factory prepiped, wired and tested. Systems shall have multistage pumps, integrated variable speed drives, UL 12 rated control panels, pressure reducers, stainless steel baseplate and panel support, 316 stainless steel suction/discharge manifolds, and Amtrol tank (150# WP) sized per the drawings. Construction shall be NSF Certified. System shall be assembled, wired, and tested at factory prior to shipment. Booster pump system shall be GRUNDFOS Hydro, Flo-Pak, Sencillo Systems or approved equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING:

A. General: Comply with the requirements of section 22 0310 for installation of basic piping materials.

B. Expansion Compensation: Except as otherwise indicated, install piping, including mains, branches and runouts with offsets to allow for free expansion and contraction sufficient to prevent leaks and over-stressing of the piping system.

C. Sterilization: The entire water distribution system shall be thoroughly sterilized with a solution containing not less than 50 parts per million of available chlorine. The chlorinating material shall be liquid chlorine conforming to Federal Specification BB-C-120. The sterilization solution shall be allowed to remain in the system for a period of 24 hours, during which time all valves and faucets shall be opened and closed several times. After sterilization, the solution shall be flushed from the system with clean water until the residual chlorine content is not greater than 0.2 parts per million. After completion of sterilization water samples shall be sent to the Local Health Department (LDH) for testing. Approval

must be received from LDH before the system is put into service.

3.2 INSTALLATION OF ACCESSORIES:

A. Install premanufactured accessories in accordance with the manufacturer's instructions and recommendations.

B. Access Panel: Install access panels as shown on drawings. Paint access panels to match walls or ceilings.

C. Escutcheon Plates: Install escutcheon plates at pipe sleeves where piping is exposed to view in occupied spaces of the building, on the exterior and elsewhere as indicated.

D. Water Hammer Arrestors: Install units at the top of each riser or as otherwise indicated to comply with PDI Standard WH-201.

E. Air Vents: Install manual air vents at high points in the system and as shown on the drawings.

END OF SECTION 22 11 10

SECTION 22 12 10 - SOIL, WASTE, VENT AND STORM PIPING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUBMITTALS:

A. Provide manufacturer's data, test reports, and product warranties as applicable for all items.

1.3 QUALITY ASSURANCE:

A. Industry Standards: Comply with local regulations, the International Plumbing Code and standards established by the Plumbing and Drainage Institute (PDI) pertaining to floor drains.

B. General: Provide factory-fabricated drainage piping products of the size and type indicated. Where not indicated, provide proper selection as determined by the Installer to comply with the installation requirements and governing regulations. Contractor shall coordinate drainage products selected with finish conditions encountered.

C. Cast Iron Pipe: All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS:

A. General: Comply with section 22 0310 for product requirements of piping materials. For each service, provide the piping materials indicated, including pipe, fittings, joints, hangers, supports, anchors and accessories. Where type is not otherwise indicated, provide materials complying with governing regulations.

B. Watts, Mifab and Wade are approved manufacturers for drainage products.

C. Soil, Waste and Vent Piping (Belowground):

1. Schedule 40 ABS-DWV or PVC-DWV pipe and fittings. Joints shall be solvent cement socket type.
2. Service weight cast iron hub and spigot pipe and fittings, ASTM A74. Joints in underground cast iron piping shall be made using an ASTM-C564 neoprene elastomeric compression gasket conforming to the requirements of ASTM C 1563.

D. Soil, Waste Drain and Vent Piping (Above Ground):

1. Schedule 40 plastic ABS-DWV or PVC-DWV pipe and fittings. Joints shall be solvent cement socket type above ground. If ABS or DWV pipe and fittings are used aboveground all penetrations of rated walls, floors, and assemblies shall be protected in an approved manner, including penetrations of one side of an assembly.
2. Hub less cast iron pipe and fittings conforming to CISPI 301 or ASTM A888. Joints in above ground cast iron shall be made using standard CISPI 310, ASTM C 1277, and ASTM C 564 stainless steel no-hub couplings or cast iron no-hub couplings.
3. Galvanized steel pipe with threaded cast iron fittings or DWV Type copper pipe with solder joint fittings may be used for waste and vent piping 1-1/2 inch and 1-1/4 inch in size.

E. Storm Drain Piping (Below Ground):

1. Schedule 40 ABS-DWV or PVC-DWV pipe and fittings. Joints shall be solvent cement socket type.
2. Service weight cast iron hub and spigot pipe and fittings, ASTM A74. Joints in underground cast iron piping shall be made using an ASTM-C564 neoprene elastomeric compression gasket conforming to the requirements of ASTM C 1563.

F. Storm Drain Piping (Above Ground):

1. Schedule 40 plastic ABS-DWV or PVC-DWV pipe and fittings. Joints shall be solvent cement socket type above ground. If ABS or DWV pipe and fittings are used aboveground all penetrations of rated walls, floors, and assemblies shall be protected in an approved manner, including penetrations of one side of an assembly.
2. Hub less cast iron pipe and fittings, CISPI 301 or ASTM A888. Joints in above ground cast iron shall be made using stainless steel no-hub standard couplings, CISPI 310, ASTM C 1277 and ASTM C564 or stainless steel no-hub heavy duty couplings, ASTM C 1540 and ASTM C 564.

2.2 FLOOR DRAINS, FLOOR SINKS, AND ROOF DRAINS:

A. Drains installed in waterproofed floors and roofs shall be provided with flashing clamps.

B. Floor Drain FD-A: shall have a coated cast iron body with integral pipe stops, flashing collar, seepage flange, vandal-proof screws and 6”x6” square diameter Nikaloy strainer. Drains shall be:

1. J.R. Smith
2. Josam
3. Watts
4. Zurn

C. Floor Drain FD-B: shall have a coated cast iron body with integral pipe stops, flashing collar, seepage flange, sediment bucket, vandal-proof screws and 9”x9” square diameter Nikaloy strainer with raised flange. Where indicated on the drawings, drain shall have a trap primer connection. Drains shall be:

1. J.R. Smith
2. Josam
3. Watts
4. Zurn

D. Floor Drain FD-C: shall have a coated cast iron body with integral pipe stops, flashing collar, seepage flange, sediment bucket, vandal-proof screws and 8”x8” square polished nickel bronze strainer. Drains shall be:

1. J.R. Smith
2. Josam
3. Zurn

E. Floor Sink FS-A: shall have a cast iron body with 8" deep porcelain enameled acid resisting interior, flashing collar, drainage flange, aluminum dome strainer and less strainer. Drains shall be:

1. J.R. Smith
2. Josam
3. Watts
4. Zurn

F. Roof Drains RD-A: shall have a coated cast iron body with adjustable top, clamp ring/gravel stop, large sump, deck clamp, drain receiver, aluminum mushroom dome, and no-hub connection. Drains shall be:

1. J.R. Smith
2. Josam
3. Watts
4. Zurn

G. Roof Drains RD-B: shall have a coated cast iron body with adjustable top, clamp ring/gravel stop, large sump, deck clamp, drain receiver, 3" cast iron standpipe, aluminum mushroom dome, and no-hub connection. Drains shall be:

1. J.R. Smith
2. Josam
3. Watts
4. Zurn

H. Hub drains shall have a pipe hub (or one pipe size increaser if plastic pipe is used) set in the floor with the top 1” above the finished floor. Waste piping from fixtures and equipment shall be connected solid into the hub unless noted otherwise on the drawings.

I. Open hub drains shall have a pipe hub (or one pipe size increaser if plastic pipe is used) set in the floor with the top 1” above the finished floor. Indirect waste piping shall terminate 2" above the top of the hub.

2.3 TRENCH DRAINS: Channels shall be 4¾” wide reveal and have a 3¼” throat. Modular channel sections shall be made of 0% water absorbent Polypropylene. Shall have a positive mechanical

connection between channel sections that will not separate during the installation and shall mechanically lock into the concrete surround a minimum of every 10". Channels shall weigh less than 2 lbs. per linear foot, have a smooth, 1.634" radiused self cleaning bottom with a Manning's coefficient of .009 neutral 0% built in slope. Channels shall have rebar clips standard to secure trench in its final location. Trench drain shall be provided with standard HPP grates that lock down with lockdown bars to the channel and is not intended for dynamic traffic loadings. Grate shall be 4-1/8" wide reveal longitudinal heelproof polypropylene grate rated class A per the DIN EN1433 top load classifications. Grate shall have an open area of 18.57 sq. in per ft. Trench drain shall be Zurn model Z-884 series, or equivalent by Watts Dead Level, PolyDrain, ACO or Quazite.

2.4 CLEANOUTS:

A. Cleanout plugs shall be cast bronze or brass countersunk type with taper threads complying with ANSI B2.

B. Cleanouts on underground drainage shall have piping extended to the floor and finished with cleanout plug and removable floor plate.

C. Cleanouts shall be the same size as the pipe on which installed, except cleanouts on underground piping shall be a maximum of 4".

D. Cleanouts in waterproofed floors shall have flashing clamp.

E. Cleanouts in carpeted floors shall be provided with a carpet marker.

F. Concrete Floors: Cleanouts shall have cast iron body with integral pipe stop, adjustable round scoriated nickel bronze cover and rim, vandalproof securing screw, and countersunk bronze plug. Cleanouts shall be:

1. J.R. Smith
2. Josam
3. Zurn
4. Watts

G. Quarry Tile or Ceramic Tile Floors: Cleanouts shall have cast iron body with integral pipe stop, adjustable square scoriated nickel bronze cover and rim, vandalproof securing screw, and countersunk bronze plug. Cleanouts shall be:

1. J.R. Smith
2. Josam
3. Zurn
4. Watts

H. Resilient Tile Floors: Cleanouts shall have cast iron body with integral pipe stop, adjustable square nickel bronze cover recessed for tile, vandalproof securing screw, and countersunk bronze plug. Cleanouts shall be:

1. J.R. Smith
2. Josam

3. Zurn
4. Watts

I. Terrazzo Floors: Cleanouts shall have cast iron body with integral pipe stop, adjustable round nickel bronze cover recessed for terrazzo, vandalproof securing screw, and countersunk bronze plug. Cleanouts shall be:

1. J.R. Smith
2. Josam
3. Zurn
4. Watts

J. Carpeted Floors: Cleanouts shall have cast iron body with integral pipe stop, adjustable round scoriated nickel bronze cover and rim, bronze carpet marker, and countersunk bronze plug. Cleanouts shall be:

1. J.R. Smith
2. Josam
3. Zurn
4. Watts

K. Exterior Areas: Cleanouts to grade shall have cast iron body with integral pipe stop, heavy duty round cast iron tractor cover with vandalproof screw, and countersunk bronze plug. Cleanouts shall be:

1. J.R. Smith
2. Josam
3. Zurn
4. Watts

L. Wall Cleanouts: shall consist of a threaded recessed tapped cleanout tee with tapered thread bronze plug, vandalproof securing screw, and round stainless steel wall plate. Cleanout shall be:

1. J.R. Smith
2. Josam
3. Zurn
4. Watts

2.5 INTERCEPTORS:

A. Grease interceptors shall be field fabricated or pre-fabricated type, as shown on the drawings.

2.6 DRAINAGE ACCESSORIES:

A. Flashing for Plumbing Vent Piping Passing Through Roofs: Unless otherwise indicated, flashing for plumbing VTR's shall be Stoneman "Stormtite" Model S1000-4, open top, 4 pound seamless lead flashing assembly or equivalent. Install flashing in accordance with manufacturer's instructions.

B. Escutcheon Plates: Metal split-ring type units, with nickel or chrome plated finish. Provide units sized to fit closely outside of pipe insulation or bare pipe where no covering is required.

C. Downspout Nozzle: Cast Nikaloy downspout nozzle with loose wall flange, insect screen and threaded inlet connection. Nozzle size shall match size of connecting storm drain pipe shown on drawings. Downspout nozzle shall be Josam 25010, J.R. Smith 1770-NB, Watts RD-940 or Zurn ZANB-199.

D. Inline Floor Drain Trap Sealer: Provide trap sealer with ASB plastic body, keeper pin neoprene rubber diaphragm and sealing gasket. Trap sealer unit shall comply with the requirements of ASSE 1072. Basis of design is Sure Seal model SS.

E. Sidewall Vent Air Inlets: Provide polished bronze body with securing mechanism and vandalproof screws. Air inlets shall be J. R. Smith 9005 or equal by Watts or Zurn.

2.7 DRAINAGE PUMPS:

A. Elevator Sump Pumps (SP-1):

1. Sump pump shall be a single stage submersible pump with NEMA 4x weathertight corrosion resistant fiberglass housing, stainless steel sensor probe, single direct plug-in power source. Pump system shall meet the requirements of UL508 and UL778. Pump shall have the capacities shown on the drawings and shall have electrical characteristics shown on the drawings.
2. Sump pump system shall include oil monitoring control system and panel. Oil monitoring control system shall include monitoring panel, alarm, light and remote monitoring circuit. Panel shall provide alarms for oil spill, power, high liquid level, overload and pump run. Oil monitoring system shall report to the fire alarm control panel.
3. Pump shall be controlled by a float switch mounted directly on the pump. Pump motor and float shall be built as a manufactured unit. Pump and oil monitoring system shall be provided as a packaged unit. Pump shall be Stancor SE Series or equal by Grundfos, Zoeller or Liberty.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING:

A. General: Comply with the requirements of section 22 0310 for installation of basic materials.

B. Testing: The piping of the soil, waste and vent system shall be tested with water before installing fixtures. Water test shall be applied to the soil, waste and venting system either in its entirety or in sections. If the test is applied to the entire system, all openings in the piping shall be closed except the highest opening, and the system shall be filled with water to the point of overflow. If the system is tested in sections, each opening of the section under test shall be plugged and each section shall be filled with water and tested with at least a 10 foot head of water. In testing successive sections, at least the upper 10 feet of the next preceding

section shall be tested so that each joint or pipe in the building except the upper most 10 feet of the system has been submitted to a test of at least 10 foot head of water. The water shall be kept in the system, or in the portion under test, for at least 30 minutes before the inspection starts; the system shall be tight at all joints. Joints that fail the test shall be remade and retested.

C. Protection: The installer of drains shall advise the Contractor of required protection for the drains during the remainder of the construction periods, to avoid clogging with construction materials and debris to prevent damage from traffic and construction work.

D. During construction all pipe openings shall be capped or plugged, when not being worked on, to prevent foreign objects and construction debris from entering system.

E. Horizontal drainage piping 2-1/2" and smaller shall be graded at a minimum of 1/4 inch per foot, unless noted otherwise. Horizontal drainage piping 3" and larger shall be graded at a minimum of 1/8 inch per foot, unless noted otherwise.

F. All underground plastic soil, waste and vent and storm drainage piping shall be installed in compliance with ASTM D2321.

G. Food Service Waste & Vent Piping: Piping shall be installed per the manufacturer's instructions. Piping shall be routed from food service area to the inlet of the grease interceptor.

3.2 INSTALLATION OF ACCESSORIES:

A. Install escutcheon plates at pipe sleeves where piping is exposed to view in occupied spaces of the building, on the exterior and elsewhere as indicated.

B. Cleanouts in vertical piping shall be roughed-in with the centerline 18" above the finished floor.

C. Install drains in accordance with manufacturer's written instructions and in locations indicated.

D. Coordinate with soil and waste piping as necessary to interface drains with drainage piping system.

E. Install drain flashing collar or flange so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.

F. Install drains at low points of the surface areas to be drained. Set tops of drains flush with finished floor or deck.

G. The installer shall advise the General Contractor of required protection for drains and cleanouts during the remainder of the construction period, to prevent damage from traffic and construction work.

H. After installation, cover the tops of drains with duct tape or some other strong material during the remainder of the construction process, to avoid clogging with construction materials and

debris.

I. Vents through the roof shall have vented covers or goosenecks to prevent rain water from entering drainage system

END OF SECTION 22 12 10

SECTION 221410 - GAS PIPING SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUBMITTALS:

A. Provide manufacturer's data, test reports, and product warranties as applicable for all items.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS:

A. General: Comply with the Section 220310 for product requirements of piping materials. For each service, provide the piping materials indicated including pipe, tube, fittings, hangers, supports, anchors, valves, and accessories. Where more than one type is indicated, selection is Installer's option.

B. Above Ground: Schedule 40 black steel pipe of the size indicated with Class 150 malleable iron threaded fittings.

C. Below Ground: Plastic pipe and fittings conforming to ASTM D2513, Grade 2406.

A. Below Slab: 2” and Smaller - Corrugated Stainless Steel Tubing (CSST)

1. Codes: ICC Codes (IFGC, IRC, IMC, IPC), NFPA 54, UPC, CAN/CSA B149.1, NFPA58.
2. Standards: ANSI LC1/CSA 6.26, UL723 (ASTM E84), ICC LC 1024, ANSIZ223.
3. Listings: CSA, ICC PMG1058, UL (Through Penetration Firestop System), FM, IAPMO ES ER-0227.
4. Pipe: Tubing shall be 300 series Stainless Steel Strip conforming to ASTM A240 rated for 5 psi and 25 psi and have an elevated pressure rating of 125G for sizes up to 1 ¼” and 25G for 1 ½” and 2”. Tubing shall not be subjected to heat treating or annealing after the corrugation forming operation.
5. Conductive Jacket**:** Jacket shall be an extruded fire- retarded engineered polymer designed to enhance the energy dissipating properties of the flexible gas piping. Conductive jacket shall conform to ASTM E-84 flame spread rating not to exceed 25 and ASTM-E84 smoke density rating shall not exceed 50, and shall be resistant to UV.
6. Fittings-shall be made of yellow brass and be tested and listed with CSA International for concealed use. Joints shall be a metal-to-metal flare seal with no gaskets and made with a stainless steel insert to pilot the tubing ID onto the fitting for a reliable flaring operation. Alternate Snap fitting listed with CSA International having an integral snap

ring requiring no disassembly or reassembly with a metal to metal cup seal. Brass fitting contains no gaskets, o-rings, or retainer rings and has a reduced torque value.

7. Quality Assurance- CSST shall be marked with the manufacturer's name, approving agencies, pressure rating.
8. Installer Qualifications- Each installer must meet applicable state and local requirements established by the AHJ and must be successfully trained through the manufacturer's installation program.
9. As an option CSST piping may be used for underground and above ground piping in accordance with the manufacturer's instruction. Pipe sizes shall be in accordance with manufacturer's requirement.

2.2 ACCESSORIES:

A. Gas Pressure Regulators: shall be diaphragm actuated with cast iron body, aluminum diaphragm chamber, and all internal parts designed for use with **[**natural**] [**LP**]** gas. Regulators shall be adjustable, with automatic loading, automatic low pressure cut-off, and full internal relief. The regulator shall be adjusted for outlet pressure indicated on the drawings. The outlet pressure shall not vary more than 1" w.c. from the set point at specified capacity. The regulator shall be capable of complete shut-off in the event the supply pressure is interrupted or the gas demand exceeds the regulator capacity and shall remain off until the regulator is manually reset. The regulator shall have a weatherproof, bug proof, screened vent cap installed in the vent tapping. Regulators shall be:

1. Regular:
   a. Sensus (Rockwell)
   b. Fisher
   c. Singer
2. With Full Relief:
   a. Sensus (Rockwell)
   b. Fisher
   c. Singer

B. Gas Solenoid Valves: Valves 3" and smaller, shall be 2-way, normally closed type with manual reset for low pressure service. The valve shall have an aluminum body, Buna N seat, and Buna N disc. Maximum pressure drop shall not exceed 1" w.c. at system capacity. The solenoid enclosure shall be NEMA 1 and have electrical characteristics as shown on the drawings. Valve shall be Underwriters Laboratories labeled. Valves shall be ASCO, Singer, or Fisher.

C. Plug Valves: Valves shall have iron body (semi-steel) lubricated type cast bronze plug, and threaded ends rated for 175 psig W.O.G. working pressure. Plug valves shall be Rockwell, Walworth, Homestead, or Powell.

D. Shutoff Valves: Valves 2" and smaller shall be ball valves. Valves shall have threaded inlet and outlet connections, two-piece brass body, meeting MSS-SP110, full or standard port, blowout-proof stem, and adjustable packing nut independent of handle. Valves shall be ASME B16.44 and UL listed for use with gas. Valve shall be rated for 250 psi, 600 CWP. Valves shall be by Maxitrol, Apollo, Hays, Milwaukee, Nibco, or Watts.

E. Flexible Hoses: Provide flexible hose connector(s) as indicated on the contract drawings or

as required to accommodate any thermal expansion, contraction, or seismic movement of the piping system. Flexible hose connectors shall be capable of compensating for lateral movement and vibration. Flexible hose connectors shall be manufactured complete with section of stainless-steel corrugated metal hose, stainless steel compatible braid, with inlet and outlet connections as required. Fitting materials of construction and end fitting type shall be consistent with pipe material and equipment/ pipe connection fittings. Copper fittings shall not be attached to stainless-steel hose. For flammable liquid or gas service up to 4", flexible hose connector shall be CSA / AGA certified. Flexible hose connector(s) shall be rated with an operating pressure of 750 psi and shall be based on burst pressure with a 4 to 1 safety factor. Hoses shall be Metraflex, Southeastern Hose, or Twin City Hoses.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SYSTEM:

A. General: Comply with the requirements of the Section 220310 for installation of basic piping materials. Install piping products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that products serve the intended function.

B. Use sealants on metal gas piping threads which are chemically resistant to natural gas. Use sealants sparingly and apply to only male threads of metal joints.

C. Remove cutting and threading burrs before assembling piping.

D. Do not install defective piping or fittings. Do not use pipe with threads which are chipped, stripped, or damaged.

E. Plug each gas outlet, including valves with a threaded cap or plug immediately after installation and retain until continuing piping or equipment connection is completed.

F. Ground gas piping electrically and continuously within project, and bond to grounding electrode. Buried bare metal piping is acceptable as a grounding electrode.

G. Install drip-legs in gas piping at regulator station and other low points in the system.

H. Grade horizontal lines 1/4" in 15' to drip-legs.

I. Support piping in accordance with the International Gas Code.

J. Plastic pipe joints shall be made using the heat-fusion method.

K. For welded pipe, the contractor shall provide test weld piping coupons for review and approval by the owner's representative prior to commencing welding of gas piping.

L. Protection of Gas Piping Against Corrosion: Protect metal gas piping in contact with the earth, or other corrosive material, against corrosion. Protect pipe with corrosion-resistant pipeline coating over a rubber-based primer by Polyken. Joints shall be primed and wrapped with Foster Cold-Applied Pipeline Joint Tape.

M. Install underground piping with a minimum 18" of cover. Trench shall be graded to provide a firm, continuous bearing for pipe. Connections between plastic pipe and steel pipe shall be made only outside, underground, and with approved transition fittings.

N. Coordinate with gas utility company as necessary to interface gas distribution piping with gas service supply work.

O. Painting: All exposed metal gas piping outside the building shall be primed and painted with dark gray enamel. All gas piping inside the building shall be painted yellow enamel.

3.2 EQUIPMENT CONNECTIONS:

A. General: Connect gas piping to equipment in accordance with the equipment manufacturer's instructions. Provide ground joint union and accessible cut-off valve at each connection to equipment.

3.3 FIELD QUALITY CONTROL:

A. Fuel Gas Piping Tightness Test: Prior to initial operation, test gas distribution piping system with air or inert gas at 3 psig or two times operating line pressure, whichever is greater. Do not use oxygen for tests.

B. Repair or replace fuel gas piping as required to eliminate leaks and retest as specified to demonstrate compliance.

END OF SECTION 221410

SECTION 221610 – PLUMBING PIPING SYSTEM INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SCOPE:

A. Plumbing piping systems to be insulated include:

1. Domestic Hot and Cold Water Piping, Above Ground
2. Horizontal Roof Drain Piping and Drain Bodies Above Floor (including secondary system)

1.3 QUALITY ASSURANCE:

A. Manufacturers: Provide insulation products produced by one of the following for each type and temperature range of insulation.

1. Certainteed
2. Knauf
3. Manville
4. Owens-Corning
5. Pittsburgh Corning

B. Flame/Smoke Ratings: Provide composite piping insulation (insulation, jackets, covering, sealers, mastics and adhesives) with flame-spread rating not exceeding 25 and smoke developed rating not exceeding 50, as tested by ASTM E 84 (NFPA 255) method and UL 723.

1.4 SUBMITTALS:

A. Provide manufacturer's data, test reports, and product warranties for all items.

PART 2 - PRODUCTS

2.1 PIPE INSULATION:

A. Fiberglass Insulation: Insulation shall be preformed, two-piece, heavy density fiberglass with self sealing ASJ jacket conforming to FS HH-I-558 Form D, Type III, and Class 12. Valves and fittings shall be insulated with fiberglass insulation of the same material thickness as

insulation on adjacent pipe and having a molded PVC jacket. Jackets shall be Certainteed Snap-Form, Knauf Proto PVC or Zeston PVC. Insulation thickness shall be as follows:

1. Domestic Hot & Cold Water Piping: 1 inch thick for all sizes.
2. Horizontal Roof Drain Piping: 1 inch thick for all sizes.

B. Aluminum Jacket: Corrugated, embossed or smooth sheet, .016 inch nominal thickness, ASTM B 209, temper H14, type 3003, 5005 or 5010. Provide stainless steel bands, minimum width of ½ inch.

PART 3 - EXECUTION

3.1 APPLICATION REQUIREMENTS:

A. General: Insulate all above ground domestic hot and cold water piping except do not insulate supplies to fixtures unless specifically required. Insulate horizontal waste lines receiving the discharge from HVAC drains. Insulate the underside of all roof drains and all roof drain piping installed above conditioned spaces.

B. Aluminum jackets shall be provided on all exterior insulated pipes.

C. In high abuse areas such as janitor closets and traffic areas in equipment rooms, kitchens and mechanical rooms aluminum jackets shall be provided. Pipe insulation to the 6 foot level shall be protected.

3.2 INSTALLATION OF PIPING INSULATION:

A. General: Install insulation products in accordance with the manufacturer's written instructions, and in accordance with recognized industry practices to ensure that the insulation serves its intended purpose. Do not use cut pieces or scraps abutting each other.

B. Insulation shall be applied on clean dry surfaces. All insulation shall be continuous through wall and ceiling openings and sleeves. Insulation on all cold surfaces, where vapor barrier jackets are used, will be applied with continuous unbroken vapor seal. Seal off ends of insulation on cold piping systems with white vapor barrier coating at valves, flanges, supports and exposed ends. Supports that are secured to cold surfaces shall be insulated and vapor sealed to prevent condensation.

C. Pipe covering protection shields shall be provided around exterior of pipe insulation at pipe hangers which fit around pipe insulation. Shields shall be 12 inches long by 180 degrees and shall be 18 gauges galvanized steel sheet. High density isolation inserts shall be provided at pipe saddles.

D. Unions shall not be insulated.

E. Cover valves, flanges, fittings and similar items in each piping system.

F. Extreme care shall be taken to insure a neat, uniform exterior surface on insulation applied to

exposed pipes. Insulation in finished areas shall be painted in accordance with the paint specifications.

G. The body (underside) of roof drains shall be insulated with blanket type fiberglass insulation. Overlap ends of insulation a minimum of 2". Overlap bottom of insulation a minimum of 3" at pipe connection. Adhere insulation to roof drain with 100% coverage of fire retardant adhesive. Tape all joints with 3" wide foil reinforced kraft tape.

3.3 PROTECTION AND REPLACEMENT:

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

B. Protection: The Installer of the insulation shall advise the Contractor of required protection for the insulation work during the remainder of the construction period, to avoid damage and deterioration.

END OF SECTION 22 16 10

SECTION 22 17 10 - PLUMBING SEISMIC CONTROL

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. Furnish all labor, materials, tools and equipment and perform all work necessary to complete the installation of the plumbing seismic control systems required by these specifications and as detailed on the drawings.

B. All foundations and supports required for the installation of plumbing equipment shall be furnished by the plumbing contractor shall unless specifically specified otherwise.

C. The following criteria applies to all mechanical systems and components:

1. Seismic Design Category: C
2. Typical Importance Factor: 1.0
3. Gas Piping Importance Factor: 1.5

D. Based on the criteria listed above, seismic restraints are required for 220130 piping only.

1.2 RELATED DOCUMENTS:

A. The drawings and general provisions of this division of the Contract, including the General and Special Conditions and Division 1 Specifications, apply to this Section.

1.3 QUALITY ASSURANCE:

A. Codes and Standards: The installation of the plumbing systems shall be installed in accordance with the following codes and standards. All seismic restraint systems such as sway bracing, cable restraints, seismic snubbers, seismic restraints, and vibration isolators shall also meet the requirements as set forth in the following standards and codes.

1. *2012 International Building Code* (IBC)
2. ASHRAE
3. SMACNA *Seismic Restraint Manual*
4. ASTM 488 *Anchor Locations*
5. FEMA Standards

B. The plumbing seismic control products shall be sized and provided by the manufacturers listed below. The manufacturer shall have tested all seismic products provided for the specific intended use and installation.

C. *Kinetics Noise Control* is the Basis of Design manufacturer. Equivalent equipment by *AeroSonics, Mason, Vibration Eliminator, Vibro-Acoustics* and *Vibration Mountings and Controls* that meets performance, capacity, space and other requirements of the design documents shall be acceptable.

D. Submittals:

1. The contractor shall submit for approval by the engineer all products intended to be used to meet the requirements of these specifications. Submittal data shall include manufacturer's data and cut sheets of the specific seismic control materials.
2. The contractor shall submit for approval by the engineer, seismic anchorage requirements for all equipment. Anchorage calculations shall be prepared by a registered engineer and in the state where the project will be constructed. The engineer shall stamp calculations. Anchorage requirements shall be submitted for all base mounted equipment, suspended equipment, and roof mounted equipment. Seismic anchorage calculations shall include an "anchorage schedule" for the contractor's use. Anchorage schedule shall list the equipment, the size and quantity of fasteners and the minimum embedment depth of anchors. Calculations may be combined for similar types of equipment provided the size and weight does not vary more than 15% and the installation manner are similar.

PART 2 - PRODUCTS

2.1 GENERAL:

A. All equipment shall be mounted or suspended from approved foundations and supports as specified herein or as detailed on the drawings.

2.2 ISOLATOR TYPES:

A. Type 5 - Floor Mounted Equipment (seismic): Vibration isolators shall be seismically rated and consist of large diameter laterally stable steel springs assembled into formed or welded steel housing assemblies designed to limit vertical movement of the supported equipment and the horizontal movement. Housing assembly shall be formed or fabricated steel members and shall consist of a top-load plate complete with adjusting and leveling bolts, isolation washers and a bottom plate with non-skid noise stop pads and holes provided for anchoring to supporting structure. Springs shall have a lateral stiffness greater than 0.8 times the rated vertical stiffness and shall be designed to provide up to 50% overload capacity. Isolator shall be designed to allow replacement of the spring element without removing the spring isolator housing.

2.3 SEISMIC CONTROL:

A. The mechanical systems serving the building shall be installed to meet the minimum requirements of the *International Building Code* regarding seismic protection and control. These specifications and the drawings indicate the minimum requirements and general intent. The actual requirements shall be determined by the seismic engineer and supplier and submitted for approval by the Mechanical Engineer.

B. The seismic engineer shall be a registered engineer in the state in which the facility is constructed and whose principal area of practice is seismic engineering and related fields.

C. All equipment installed either floor or pad mounted or suspended from the structure shall be restrained and anchored unless exempt as hereinafter indicated.

D. Where pipes or other plumbing systems cross the seismic isolation interface between two seismically isolated structures, the systems shall have flexible pipes to accommodate the seismic displacement of the two structures. Flexible pipes shall be installed on one side of the interface.

E. The following plumbing components are exempt from seismic bracing or restraints:

1. All components in seismic design category D, E, and F, weighing 20 lbs or less when the importance factor = 1.0.
2. Piping installed 12” or less from the point of connection to the supporting structure and the top of the pipe when the importance factor = 1.0.
3. Equipment installed less than 4’-0” above the floor and weighing less than 400 lbs when the importance factor = 1.0.
4. Any piping installed in a structure when the Seismic Design Category is A or B.
5. Any piping installed in a structure when the Seismic Design Category is C and the importance factor = 1.0.

F. Where systems are specified to have spring isolation hangers, the hangers shall be installed as close as possible to the supporting structure.

G. Seismic restraint cables or seismic restraint braces shall be installed on piping systems and suspended equipment. Seismic restraint cables shall be stranded steel cable provided with mounting hardware for connection to the equipment hanger rod, to the equipment housing or trapeze hangers. The stranded steel cables and hardware shall be the product of a single manufacture and shall have been tested for the intended use. Published data shall be available and submitted to identify the load limitations of the proposed restraint hardware. As a minimum the following cable sizes shall be used on piping and equipment:

1. Piping 1” to 2 ½”: 1/16” steel cable
2. Piping 3” to 8”: 3/16” steel cable
3. Piping 10” and larger: 1/4” steel cable
4. Equipment weighting 400 lbs or less: 3/16” steel cable
5. Equipment weight 401 lbs and higher: 1/4” steel cable

H. Anchorage of equipment to concrete floors and pads shall be in-accordance with the submitted anchorage calculations.

I. Connections of seismic restraint cable hardware shall be in-accordance with the submitted anchorage calculations.

PART 3 - EXECUTION

3.1 GENERAL:

A. If the equipment provided is not furnished with integral structural steel supports, mounting feet or lifting lugs, the contractor shall provide miscellaneous steel shapes as required to install or suspend the equipment and attach the vibration isolation or seismic restraints as specified herein.

B. Support steel shall include but not be limited to rails, brackets, angles, channels, and similar components.

C. All seismic restraint products shall be installed as outlined in the manufacturer's printed installation instructions.

3.2 SEISMIC CERTIFICATE OF COMPLIANCE:

A. The manufacturer's representative shall be responsible for providing such assistance and supervision as necessary to assure a correct installation and adjustment of seismic products.

B. The manufacturer's representative shall visit the installation once all installed items have been completed but prior to the installation of ceilings or walls that may conceal any devices and inspect the installation for compliance with the manufacturer's installation instructions. Upon satisfaction that all devices are installed correctly and systems are isolated properly, the representative shall submit a written report outlining the installation as in compliance with these specifications and also the manufacturer's installation instructions.

END OF SECTION 22 17 10

SECTION 22 22 10 – WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:

A. Industry Standards:

1. Provide electric water heaters which have been listed and labeled by Underwriters' Laboratories.
2. Comply with National Electrical Code (NFPA 70) as applicable to installation and connection to electric water heaters.
3. Provide water heaters which have been listed and labeled by National Sanitation Foundation (NSF).
4. Provide water heaters with safety relief valves bearing ASME valve markings, all heaters.
5. Comply with American Gas Association (AGA) as applicable to certification of gas-fired water heaters.
6. Heaters(s) shall meet the requirements of ASHRAE 90.1-2007, state energy requirements, and the BOCA Energy Conservation Code.

1.3 SUBMITTALS:

A. Provide manufacturer's data, test reports, certifications and product warranties on all items.

PART 2 - PRODUCTS

2.1 GAS-FIRED WATER HEATERS:

A. Instantaneous Gas Floor Mounted Water Heaters WH-1 & WH-F1:

1. Water heater shall be direct fired, fully condensing, water-tube design. Power burner shall have full modulation. The minimum firing rate shall not exceed 30,000 BTU/HR input. Water heaters that have an input greater than 30,000 BTU/Hr at minimum fire will not be considered equal. The water heater shall have the capability of discharging into a positive pressure vent. Water heater thermal efficiency shall increase with decreasing load (output), while maintaining set point. Water heater shall have an operational set point capability of 100 ºF to 190 ºF and shall maintain the outlet temperature within an accuracy of +/- 4 ºF during load changes of up to 30% rated capacity. Water heater shall be factory-fabricated, factory-assembled and factory-tested, water-tube condensing water heater with heat exchanger sealed pressure-tight, built on a steel base, including a sealed

insulated sheet metal enclosure that acts as combustion-air intake plenum with a built in serviceable air filter.

2. Heat Exchanger: The heat exchanger shall be constructed with 316L stainless steel helical water tube, fully floating with no welded joints in the exchanger. The exchanger will have a single-pass unitary design (no separate primary and secondary heat exchanger). The water tubes shall be 0.75" ID, with no less than 0.0472" wall thickness.. The heat exchanger shall be ASME Sect IV (HLW) stamped for a working pressure not less than 160 psig.
3. Modulating Air/Fuel Valve and Burner: The water heater burner shall be capable of a -33.3 to 1 turndown ratio of the firing rate without loss of combustion efficiency or staging of gas valves. The burner shall be stainless fiber mesh covering a stainless steel body with spark ignition and flame rectification. All burner material exposed to the combustion zone shall be of stainless steel construction. There shall be no moving parts within the burner itself. A modulating air/fuel valve shall meter the air and fuel input. A variable frequency drive (VFD), controlled pre-mix blower shall be used to ensure the optimum mixing of air and fuel between the air/fuel valve and the burner.
4. The exhaust manifold shall be of polypropylene with 6" diameter flue connection
5. Ignition shall be via spark ignition with 100 percent main-valve shutoff and dual electronic flame supervision.
6. The water heater control system shall be a Masterless Cascading design. Lead Lag – master / slave control systems will not be permitted. The entire system shall have built-in usage optimization routine.
7. Condensate traps shall be manufactured from only non-corrosive materials.
8. Water heaters shall be by:

    1. INTELLIHOT IQ
    2. AERCO
    3. TRIANGLE TUBE

B. Instantaneous Gas Water Heaters (WH-2 thru WH-7, WH-M1 & WH-F2):

1. Water heater shall be direct fired, fully condensing, water-tube design. Power burner shall have full modulation. The minimum firing rate shall not exceed 30,000 BTU/Hr input. Water heaters that have an input greater than 30,000 BTU/Hr at minimum fire will not be considered equal. The water heater shall have the capability of discharging into a positive pressure vent. Water heater thermal efficiency shall increase with decreasing load (output), while maintaining set point. Water heater shall have an operational set point capability of 90 ºF to 185 ºF and shall maintain the outlet temperature within an accuracy of +/- 2 ºF during load changes of up to 100% rated capacity. Heater shall operate quietly, less than 55 dba. Water heater shall be factory-fabricated, factory-assembled and factory-tested, water-tube condensing water heater with heat exchanger sealed pressure-tight, built on a steel base, including a sealed insulated sheet metal enclosure that acts as combustion-air intake plenum.
2. Heat Exchanger: The heat exchanger shall be constructed with 316L stainless steel helical water tubes, fully floating with no welded joints in the exchanger. The exchanger will have a single-pass combustion gas flow design. The water tubes shall be 3/4" ID, with no less than 0.0469" wall thickness.
3. Hybrid Tank: The shell assembly of the hybrid tank vessel shall have a maximum water volume of less than .6 gallon. The water heater water connections shall be 3/4 inch Flanged O Ring connections. The shell assembly shall be constructed of 316L stainless steel of 0.0488 inch wall thickness or above.

4. Modulating Air/Fuel Valve and Burner: The water heater burner shall be capable of a 7 to 1 turndown ratio of the firing rate without loss of combustion efficiency or staging of gas valves. The burner shall be stainless fiber mesh covering a stainless steel body with spark ignition and flame rectification. All burner material exposed to the combustion zone shall be of stainless steel construction. There shall be no moving parts within the burner itself. A modulating air/fuel valve shall meter the air and fuel input. A variable frequency drive (VFD), controlled pre-mix blower shall be used to ensure the optimum mixing of air and fuel between the air/fuel valve and the burner.
5. The exhaust manifold shall be of PVC, CPVC, polypropylene, stainless steel (AL29-4C) with a 3 inch diameter flue connection.
6. Ignition: Ignition shall be via spark ignition with 100 percent main-valve shutoff and electronic flame supervision.
7. The water heater control system shall be a masterless cascading design. Lead Lag – master / slave control systems will not be permitted. The entire system shall be ETL recognized.
8. Condensate traps, manufactured from only non-corrosive materials.
9. Water heaters shall be by:

    1. INTELLIHOT
    2. A.O. SMITH
    3. TRIANGLE TUBE
    4. RHEEM
    5. RINNAI
    6. LOCHINVAR

2.2 ELECTRIC WATER HEATERS:

A. Point-of-use tankless Water Heater (3-10 KW): Provide a thermostatically controlled tankless instantaneous type electric water heater sized for low flow constant temperature requirements. Unit shall have an ABS UL rated 94V0 cover, integral flow switch, replaceable cartridge insert type heating element, high temperature limit switch with automatic reset, replaceable cold water inlet filter, and compression fittings located on top or bottom of unit. Unit shall be wall mountable, UL Listed and have a minimum 5 year (heater) / 1 year (parts) warranty. Flow switch shall activate heating element only on demand with a maximum turn on of 0.3 GPM. Unit shall operate at 25 psi minimum and 150 psi maximum. Provide with integral flow controller and faucet aerator. Units schedule as dual lavatory shall be provided with two faucet aerators. Refer to the schedule for application type and heater size. Refer to electrical drawings for voltage and phase requirements. Instantaneous water heater shall be by:

    1. EEMAX
    2. RHEEM
    3. CHRONOMITE

B. Point-of-use tankless Water Heater (Greater than 20 KW): Provide a thermostatically controlled tankless instantaneous type electric water heater. Unit shall regulate power to required flow. Unit shall have three replaceable cartridge insert type heating elements, high temperature limit switch with automatic reset, replaceable cold water inlet filter, and compression fittings located on bottom of unit. Unit shall be wall mountable, UL Listed and have a minimum 5 year (heater) / 1 year (parts) warranty. Flow switch shall activate heating

element only on demand. Unit shall operate at 25 psi minimum and 150 psi maximum. Refer to the schedule for application type & heater size. Refer to electrical drawings for voltage and phase requirements. Instantaneous water heater shall be by:

1. EEMAX
2. RHEEM
3. CHRONOMITE

2.3 ACCESSORIES:

A. Domestic Hot Water Circulation Pump: Pump shall be the in-line centrifugal type designed for 125 psi working pressure with bronze body and impeller, mechanical seals and stainless steel impeller shaft. The pump motor shall be the open drip-proof design with sleeve bearings, built-in thermal over-load protectors, and shall operate at 1750 RPM. Pump shall have the capacities as shown on the drawings. Pump shall be:

1. Bell & Gossett - Booster Series
2. Taco - Circulation Series
3. Thrush - Circulator Series
4. Grundfos - UP Circulator Series

B. Thermal Expansion Tanks: Provide bladder type captive air expansion tanks with tank volume as indicated on the drawings. The shell shall be fabricated steel designed and constructed per ASME Section VIII. Tanks shall be suitable for potable water systems and maximum working pressure of 125 psig and a maximum operating temperature of 240 degrees F. Tanks shall be by Taco, Amtrol, Watts, Proflo or Wheatley.

C. Vacuum Relief Valve: Provide a vacuum relief valve for automatic venting of a closed system to atmosphere when a vacuum is created. Valve shall be tested and rated under ANSI Z21.22. Vacuum relief valve shall be a Watts LFN36, Cash-Acme FRM-V, or Wilkins VR10XL.

D. Temperature Control Valve: Assembly shall be a Hi-Low Thermostatic Water Mixing Valve with large mixing valve with solid bimetal thermostat directly linked to valve porting, adjustable limit stop, color coded scale: Hot to Cold, wall support, inlet union angle stainer checkstops, outlet volume control/shutoff, pressure regulating valve with pressure gauges, small Mixing Valve, integral checkstops, solid bimetal thermostat, adjustable limit stop, color coded scale; Cold to Hot, wall support outlet volume control/shutoff dial thermometer (range: 0 to 140 degrees F, -10 to 60 degrees C), rough bronze finish, and inlet piping manifold with unions. Unit shall be FACTORY ASSEMBLED AND TESTED. Temperature control valve shall be LEONARD TM-186-12520 PRV-D-LTR or equivalent by Powers or Lawler.

E. Temperature Control Valve: Valve shall be a thermoscopic mixing valve with chrome finish, a maximum operating pressure of 125 PSIG and maximum operating temperature of 110ºF at 45 PSIG equal supply pressures. Valve shall be provided with spring loaded angle union integral check stops, integral strainers and “Fail Safe” shutdown. Valve shall control temperature at ±1ºC and shall have minimum and maximum flow rates of 1 gallon per minute and 26 gallons per minute respectively. Temperature Control Valve shall be RADA Model 20 or equal by Leonard, Symmons or Powers.

F. Equipment Stand: Stand shall be galvanized steel unit with 12 gauge galvanized steel top, 16 gauge galvanized steel legs, lag bolts, washers and safety clips. Stand shall be rated to carry a capacity of 1200 pounds. Equipment stand shall be by Holdrite Quick Stand series or equal.

G. Water Heater Pan: Water heater pan shall be aluminum alloy pan with 2½" high sides, 1" PVC drain, zinc plated steel lock nut and neoprene flange gasket. Water heater pan shall be shall be by Holdrite Quick Pan series or equal.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install water heaters and accessories where shown, in accordance with equipment manufacturer's written instructions and with recognized industry practices. Comply with requirements of state and local codes and applicable NFPA and ASME Boiler and Pressure Vessel Code Standards.

B. Flush water heaters upon completion of installation in accordance with manufacturer's instructions.

C. Start-up water heaters in accordance with manufacturer's written procedures, upon completion of heater installation and demonstrate compliance with requirements.

3.2 FIELD QUALITY CONTROL:

A. Test assembled water heater and accessories in accordance with applicable sections of ASME Boiler and Pressure Vessel Code.

END OF SECTION 22 22 10

SECTION 22 31 10 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:

A. Industry Standards: Comply with ANSI Standards pertaining to plumbing fixtures and systems.

B. Comply with ANSI A117.1 standard pertaining to plumbing fixtures for handicapped.

C. Comply with standards established by Plumbing and Drainage institute (PDI) pertaining to plumbing fixture supports.

D. Comply with applicable Federal Standard FS WW-P-541/Series sections pertaining to plumbing fixtures.

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURES:

A. General: Provide factory-fabricated fixtures of the type, style and material indicated. For each type of fixture, unless otherwise specified, provide fixture manufacturer's standard trim, carrier seats and valves as indicated by their published product information, either as designed and constructed, or as recommended by the manufacturer, and as required for a complete installation. Where more than one type or manufacturer is indicated, selection is Installer's option.

2.2 MATERIALS:

A. General: Unless otherwise specified, comply with applicable Federal Specification WW-P-541/series sections pertaining to plumbing fixtures, fittings, trim, metals and finishes. Comply with requirements of WW-P-541/specification relative to quality of ware, glazing, enamel, composition and finish of metals, air gaps and vacuum breakers, even though some plumbing fixtures specified in this section are not described in WW-P-541.

B. Unless otherwise specified, faucets shall comply with National Sanitation Foundation International NSF Standard 61, and where applicable NSF Standard 61, Section 9. Faucets shall be NSF certified, and bear the NSF mark.

C. Provide materials which have been selected for their surface flatness and smoothness. Exposed surface which exhibit pitting, seam marks, roller marks, foundry sand holes, stains, discoloration or other surface imperfections on finished units are not acceptable.

D. Where fittings, trim and accessories are exposed or semi-exposed, provide bright chrome-plated or polished stainless steel units.

E. Vitreous China: High quality, free from fire cracks, spots, blisters, pinholes and speck; glaze exposed surfaces and test for crazing resistance in accordance with ASTM C 554.

F. Vitreous China and Enamel Iron Fixtures shall be white unless specified otherwise.

G. Comply with additional fixture requirements contained in the fixture schedule.

H. In addition to the manufacturers list below, the following manufacturers are approved for all lavatory, service sink, can wash and sink faucets: Kohler, American Standard, Eljer, Chicago, Zurn, T & S Brass, Symmons, Speakman, Elkay and Just.

I. In addition to the manufacturers list below, the following manufacturers are approved for all vitreous china and cast iron plumbing fixtures Zurn One, Eljer and Sloan.

J. Dearborn is an approved manufacturer for insulation kits.

K. Flush valves shall be the size, roughing height, and flow rate specified hereinafter for each fixture. Flush valve shall be a diaphragm actuated type with chrome plated exterior, angle stop with cover, vacuum breaker, adjustable tailpiece, and cast escutcheon with setscrew. Where shown on the drawings provide a trap primer connection in the valve tailpiece. All flush valves specified to be 24” roughing shall be provided with wall brace.

K. All low voltage wiring, sensors, and transformers shall be provided under this section with the hardwired flush valves and/or faucets.

L. Toilet seats shall be same color as fixture. Seats shall be open front without cover, and solid molded plastic with self-sustaining check hinge. Seats shall be for elongated bowl unless specified otherwise.

M. Carriers shall be commercial grade and selected to match the fixtures for which they are used. Carriers shall be floor mounted and designed to transfer any fixture loading to the floor and not the wall unless specified otherwise. Carriers provided for wall hung urinals shall be two plate type. Carriers for wall hung water closets and urinals shall be provided with chrome plated mounting hardware.

N. Fixture stops shall be provided for all fixtures and shall be chrome plated with cast escutcheons with set screws. Stops for flush valves shall be by the flush valve manufacturer. Stops for shower valves shall be either angle or straight type and shall be concealed behind the shower cover plate. Stops for lavatories and sinks shall be loose key or wheel handle type by manufacturers shown as specified for each fixture.

O. Fixture drains shall be by the same manufacturer as the lavatory and sink faucets, with a matching finish. Lavatory and sink drains shall be pop-up, grid, or crumb cup type as specified for each fixture. Drains shall be chrome plated brass or stainless steel unless noted

otherwise. Drain tailpieces shall be minimum 17 gauge chrome plated cast brass.

P. All p-traps, continuous wastes and fixture drain piping shall be 17 gauge chrome plated cast brass and of the size indicated in the fixture schedule on the plumbing drawings.

Q. Insulation kits shall be provided for all handicap lavatories and sinks with exposed supply and waste piping. Insulation kits shall include covers for fixture drains, p-traps and supplies.

2.3 PLUMBING FIXTURE SCHEDULE:

A. Water Closet P-1A: shall be a floor mounted, floor outlet, vitreous china, siphon jet water closet with elongated bowl (designed for 1.28 gallon flush), 1-1/2" top spud, floor bolts, bolt caps, and outlet gasket. The water closet shall be fitted with a white seat and 1-1/2" (11-1/2" roughing) flush valve. Water closet and trim shall be:

Water Closet:	AMERICAN STD.	KOHLER	ZURN
Flush Valve:	SLOAN	DELANY	ZURN
Seat:	PLUMBTECH	BEMIS	ZURN

B. Water Closet P-1B: shall be an ADA compliant floor mounted, floor outlet, vitreous china, siphon jet water closet with elongated bowl (designed for 1.28 gallon flush), 1-1/2" top spud, floor bolts, bolt caps, and outlet gasket. The water closet shall be fitted with a white seat and 1-1/2" (11-1/2" roughing) flush valve. Water closet and trim shall be:

Water Closet:	AMERICAN STD.	KOHLER	ZURN
Flush Valve:	SLOAN	DELANY	ZURN
Seat:	PLUMBTECH	BEMIS	ZURN

C. Urinal P-2A: shall be a wall hung, vitreous china, washout urinal (designed for 0.125 gallon flush), 2” outlet, 3/4” top spud and wall hangers. The urinal shall be fitted with a 3/4" (11-1/2” roughing) flush valve and back plate. Urinal shall be:

Urinal:	AMERICAN STD.	KOHLER	ZURN
Flush Valve:	SLOAN	DELANY	ZURN

D. Urinal P-2B: shall be the same as urinal P-2A except for the mounting height. Refer to plumbing fixture schedule for mounting height.

E. Lavatory P-3A: shall be a lavatory bowl integral with the countertop and provided by others. The lavatory shall be fitted with a chrome plated ADA compliant pushbutton metering faucet, thermostatic mixing valve, perforated offset grid drain, 1-1/4" p-trap, loose key angle supplies, and insulation kit. Lavatory and trim shall be:

Faucet:	CHICAGO	ZURN	MOEN COMM
Mixing Valve:	CHICAGO	ZURN	MOEN COMM
Drain:	McGUIRE	ZURN	WATTS
P-trap:	McGUIRE	ZURN	WATTS
Supplies:	McGUIRE	BRASS CRAFT	WATTS
Insulation Kit:	McGUIRE	TRUEBRO	SKAL-GUARD

F. Lavatory P-3B: shall be a wall hung, 20" x 18" vitreous china lavatory with back splash and

punched for 4" centers. The lavatory shall be fitted with a chrome plated ADA compliant center-set faucet with single lever handle and low flow aerator (0.5 gpm), thermostatic mixing valve off-set perforated grid drain, 1-1/4" p-trap, loose key angle supplies, chair carrier with concealed arm supports and insulation kit. Lavatory and trim shall be:

Lavatory:	AMERICAN STD.	KOHLER	ZURN
Faucet:	CHICAGO	ZURN	MOEN COMM
Mixing Valve:	CHICAGO	ZURN	MOEN COMM
Drain:	McGUIRE	ZURN	WATTS
P-trap:	McGUIRE	ZURN	WATTS
Supplies:	McGUIRE	BRASS CRAFT	WATTS
Insulation Kit:	McGUIRE	TRUEBRO	SKAL-GUARD
Carrier:	J.R. SMITH	JOSAM	ZURN

G. Lavatory P-3C: shall be a wall hung, 20" x 18" vitreous china lavatory with back splash and punched for 4" centers. The lavatory shall be fitted with a chrome plated ADA compliant pushbutton metering faucet, thermostatic mixing valve off-set perforated grid drain, 1-1/4" p-trap, loose key angle supplies, chair carrier with concealed arm supports and insulation kit. Lavatory and trim shall be:

Lavatory:	AMERICAN STD.	KOHLER	ZURN
Faucet:	CHICAGO	ZURN	MOEN COMM
Mixing Valve:	CHICAGO	ZURN	MOEN COMM
Drain:	McGUIRE	ZURN	WATTS
P-trap:	McGUIRE	ZURN	WATTS
Supplies:	McGUIRE	BRASS CRAFT	WATTS
Insulation Kit:	McGUIRE	TRUEBRO	SKAL-GUARD
Carrier:	J.R. SMITH	JOSAM	ZURN

H. Lavatory P-3D: shall be a lavatory bowl integral with the countertop and provided by others. The lavatory shall be fitted with a chrome plated ADA compliant pushbutton metering faucet (cold water only), perforated offset grid drain, 1-1/4" p-trap, loose key angle supplies, and insulation kit. Lavatory and trim shall be:

Faucet:	CHICAGO	ZURN	MOEN COMM
Drain:	McGUIRE	ZURN	WATTS
P-trap:	McGUIRE	ZURN	WATTS
Supplies:	McGUIRE	BRASS CRAFT	WATTS
Insulation Kit:	McGUIRE	TRUEBRO	SKAL-GUARD

I. Mop Sink P-4: shall be a 24" x 24" molded stone mop basin with 10" high sides and integral 3" chrome plated dome drain. The mop sink shall be fitted with vinyl bumper guards, a chrome plated faucet with vacuum breaker, a hose with hose bracket, and stainless steel wall guards. Mop sink shall be white and the faucet shall be mounted on the wall 36 inches above the floor. Mop basin shall be:

Basin:	FIAT	SWAN	ZURN
Bumperguards:	FIAT	SWAN	ZURN
Faucet:	FIAT	SWAN	ZURN
Hose/Bracket:	FIAT	SWAN	ZURN
Wall Guards:	FIAT	SWAN	ZURN

J. Classroom Sink P-5A: shall be an 18 gauge, type 302 stainless steel, ADA compliant, self-rimming sink with 25" x 17" x 4" deep overall dimensions, single bowl, and punched for a single hole on left and right ledges for cold water faucet and bubbler with underside sound deadened. The sink shall be fitted with a chrome plated single gooseneck faucet (minimum 5" centerline to gooseneck) with quarter turn lever handle for cold water only and low flow aerator (1.5 gpm), brass bubbler with flexible shield, offset crumb cup drain, 1-1/2" p-trap, and loose key angle supplies. Provide independent shutoff valve for isolation of bubbler. Sink shall be:

.

Sink:	JUST	ELKAY	MOEN COM.
Bubbler:	JUST	ELKAY	MOEN COM.
Faucet:	ZURN	T & S BRASS	CHICAGO
Drain:	McGUIRE	ZURN	WATTS
P-Trap:	McGUIRE	ZURN	WATTS
Supplies:	McGUIRE	ZURN	WATTS

K. Work Sink P-5B: shall be an 18 gauge, type 302 stainless steel, ADA, self-rimming sink with 21" x 19" x 6-1/2" deep overall dimensions, single bowl, punched for 3 holes on 4” centers with underside sound deadened. The sink shall be fitted with a chrome plated ADA compliant spread gooseneck faucet with quarter turn 4” wrist blade handles and low flow aerator (1.5 gpm), offset crumb cup drain, 1-1/2" p-trap and continuous waste. Sink and trim shall be:

Sink:	JUST	ELKAY	MOEN COM.
Faucet:	ZURN	T & S BRASS	CHICAGO
Drain:	McGUIRE	ZURN	WATTS
P-Trap:	McGUIRE	BRASS CRAFT	WATTS
Supplies:	McGUIRE	ZURN	WATTS

L. Clinic Sink P-5C: shall be an 18 gauge, type 302 stainless steel, ADA, self-rimming sink with 21" x 19" x 6-1/2" deep overall dimensions, single bowl, punched for 3 holes on 4” centers with underside sound deadened. The sink shall be fitted with a chrome plated deck mounted faucet with gooseneck spout, polished chrome plated floor mounted, slow closing, double pedal mixing valve and low flow aerator (1.5 gpm), off-set offset crumb cup drain, 1-1/2" p-trap, continuous waste, plug loose key angle supplies and insulation kit. Sink and trim shall be:

Sink:	JUST	ELKAY	MOEN COM.
Faucet:	ZURN	T & S BRASS	CHICAGO
Foot Pedal:	ZURN	T & S BRASS	CHICAGO
Drain:	McGUIRE	ZURN	WATTS
P-Trap:	McGUIRE	ZURN	WATTS
Supplies:	McGUIRE	BRASS CRAFT	WATTS
Insulation Kit:	McGUIRE	TRUEBRO	SKAL-GUARD

M. Kitchen Sink P-5D: shall be an 18 gauge, type 302 stainless steel, self-rimming sink with 21" x 33" x 6-1/2" deep overall dimensions, double bowl, punched for 3 holes on 4" centers with underside sound deadened. The sink shall be fitted with a chrome plated ADA compliant spread single lever faucet with swing spout and low flow aerator (1.5 gpm), off-set crumb cup drain, 1-1/2" p-trap, continuous waste, loose key angle supplies and insulation kit.

Sink and trim shall be:

Sink:	JUST	ELKAY	MOEN COM.
Faucet:	JUST	ELKAY	MOEN COM.
Drain:	McGUIRE	ZURN	WATTS
P-Trap:	McGUIRE	ZURN	WATTS
Supplies:	McGUIRE	BRASS CRAFT	WATTS
Insulation Kit:	McGUIRE	TRUEBRO	SKAL-GUARD
Disposer:	INSINKERATOR	WASTE KING	MOEN

N. Art Sink P-5E: shall be an 18 gauge, type 302 stainless steel, self-rimming sink with 21" x 19" x 10-1/2" deep overall dimensions, single bowl with underside sound deadened. The sink shall be fitted with a chrome plated ADA compliant spread gooseneck faucet with quarter turn 4" wrist blade handles and low flow aerator (1.5 gpm), offset crumb cup drain, 1-1/2" solids interceptor and continuous waste. Sink and trim shall be:

Sink:	JUST	ELKAY	MOEN COM.
Faucet:	ZURN	T & S BRASS	CHICAGO
Drain:	McGUIRE	ZURN	WATTS
P-Trap:	McGUIRE	ZURN	WATTS
Supplies:	McGUIRE	BRASS CRAFT	WATTS
Interceptor:	ZURN	J.R. SMITH	JOSAM

O. Art Sink P-5F: shall be an 18 gauge, type 302 stainless steel, ADA, self-rimming sink with 21" x 19" x 6-1/2" deep overall dimensions, single bowl with underside sound deadened. The sink shall be fitted with a chrome plated ADA compliant spread gooseneck faucet with quarter turn 4" wrist blade handles and low flow aerator (1.5 gpm), offset crumb cup drain, 1-1/2" solids interceptor and continuous waste. Sink and trim shall be:

Sink:	JUST	ELKAY	MOEN COM.
Faucet:	ZURN	T & S BRASS	CHICAGO
Drain:	McGUIRE	ZURN	WATTS
P-Trap:	McGUIRE	ZURN	WATTS
Supplies:	McGUIRE	BRASS CRAFT	WATTS
Interceptor:	ZURN	J.R. SMITH	JOSAM

P. Classroom Sink P-5G: shall be the same as sink P-5A except for H&C supply. Refer to schedule for mounting height.

Q. Shower P-6A: shall consist of a single handle pressure balanced mixing valve with integral stops and vandal proof trim, a shower head and arm, and a 2" floor drain. The shower head shall include chrome plated brass head and supply arm with wall flange. Maximum flow rate shall be 1.5 gpm. The floor drain shall be a type "A" as specified in Section 22 1210. The shower head and mixing valve shall be:

Shower Valve:	SPEAKMAN	SYMMONS	POWERS
Shower Head:	SPEAKMAN	SYMMONS	POWERS

R. Shower P-6B: shall consist of a single handle pressure balanced mixing valve with integral stops and vandal proof trim, a hand shower, and a 2" floor drain. The hand shower shall include hand shower with swivel base, 24" slide bar, 60"chrome plated brass hose with

rubber liner, supply ell with wall flange, in-line vacuum breaker and quick connect coupling. Maximum flow rate shall be 1.5 gpm. The floor drain shall be a type "A" as specified in Section 22 1210. The hand shower and mixing valve shall be:

Shower Valve:	SPEAKMAN	SYMMONS	POWERS
Hand Shower:	SPEAKMAN	SYMMONS	POWERS
Quick Connect:	SPEAKMAN	SYMMONS	POWERS

S. Ice Maker Box P-7: shall be a recessed flush mounting plastic or painted steel box with ¼ turn cold water angle valve and water hammer arrestor. Ice maker box shall be:

OATEY
GUY GRAY
WATER TITE

T. Washing Machine Connection Box P-8: shall be a recessed flush mounting plastic or painted steel box with ¼ turn cold and hot water angle valves with hose thread outlets and water hammer arrestors, and plugged 2" drain outlet. Washer box shall be:

OATEY
GUY GRAY
WATER TITE

U. Condensate Drain Box P-9: shall be a recessed flush mounting painted steel box with plugged 2" drain outlet. Box shall have a stainless-steel cover with latch and approved for installation in rated walls (if applicable). Condensate Drain Box shall be:

GUY GRAY
OATEY
PLASTIC ODDITIES
SIOUX CHIEF.

V. Emergency Shower and Eyewash P-10: shall be a free-standing unit consisting of stainless steel shower head, chrome plated brass 1" self closing ball type shower valve with galvanized steel pull ring, 1-1/4" galvanized steel piping, heavy aluminum floor flange, stainless steel eyewash bowl with dome strainer, (2) chrome plated brass eyewash heads and piping with integral flow controls and spray head dust covers, tempering valve for blending cold and hot water, and chrome plated brass stay open eyewash valve with push flag handle. Shower/Eyewash shall be provided with safety station sign and 1-1/4" chrome plated brass p-trap with extension. Emergency Shower/Eyewash shall be:

BRADLEY
HAWES
GUARDIAN

W. Emergency Eyewash P-11: shall be a counter mounted swing-away type unit consisting of (2) eyewash heads with integral flow controls and spray head dust covers mounted on swing-away arm assembly, push handle operated stay-open valve. All exposed parts shall be chrome plated brass. Eyewash shall be provided with safety station sign. Eyewash shall be:

BRADLEY
HAWES
GUARDIAN

X. Whirlpool Connection P-12: shall consist of a thermostatic mixing valve and hub drain. The thermostatic mixing valve (TMV) shall be of chrome plated brass, stainless steel and polymer construction. TMV shall have NPT inlets with integral inlet spring loaded check stop valves and strainers, vacuum breaker, thermometer and hose outlet. Mixing valves shall be equipped with a maximum temperature limiting and single temperature locking feature. TMV shall be designed so that all internal operating components are enclosed in a one-piece replaceable cartridge for ease of service. Valves shall be capable of controlling mixed water temperatures +/- 2 degrees F at flow rates between 1 and 24 gpm. Mixing valve shall be:

ARMSTRONG/RADA
LEONARD
LAWLER

Y. Can Wash Faucet P-13: shall be chrome plated faucet with vacuum breaker, a hose with hose bracket. Can Wash Faucet shall be::

T & S BRASS
ZURN
CHICAGO

Z. Washfountain P-14: shall be a floor mounted, ADA-compliant, 4 station 54" semi-circular washfountain with 34" nominal rim height, stainless steel bowl, stainless steel pedestal panels, stainless steel backsplash and stainless steel sprayhead and support tube. The sink shall be constructed of 14 gauge type 304 stainless steel polished to a # 4 finish. The sink shall be provided with drain strainer and 1 1/2" tailpiece welded to basin, (4) infrared faucets, liquid soap dispensers, thermostatic mixing valve, and ½" hot and cold water supplies with check stops. Sink shall be by:

BRADLEY
ACORN
NEO-METRO

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install plumbing fixtures of types indicated where shown and at indicated heights or where not shown in accordance with manufacturer's written instruction, roughing-in drawings and with recognized industry practices.

B. Install all low voltage wiring, sensors, and transformers furnished with the hardwired flush valves and/or faucets. 120V power connections for the low voltage transformers shall be connected by the Division 26 contractor in accordance with specification section 261010. All low voltage wiring and needed pathways shall be provided under this section. Provide needed pathway/chase to form an accessible pathway from each sensor location to a point within 6"

of low voltage transformer, and terminate with insulated throat bushing. Wiring installed in an open plumbing chase can be installed without conduit.

C. Fasten plumbing fixtures securely to indicated supports or building structure, and ensure that fixtures are level and plumb and tight against mounting surface.

D. Seal the outer perimeter of wall mounted lavatories and urinals and water closets to the wall and floor mounted water closets to the floor with a smooth bead of white silicone compound.

E. All fixtures provided under another division of the specifications shall be roughed-in and connected under this section. Provide individual shut-off valves or supply stops to all fixtures with a water or gas supply. Provide p-traps and extensions to waste stack in wall or to drain, as shown on the drawings, if not provided by the fixture supplier. Supply stops and p-traps shall be McGUIRE, EBC, or BRASS-CRAFT.

F. Provide and install undercounter mixing valves for all sinks and lavatories except those in commercial kitchens.

3.2 FIELD QUALITY CONTROL:

A. Upon completion of installation of plumbing fixtures and after units are water pressurized, test and adjust fixtures for proper operation.

END OF SECTION 22 31 10

SECTION 22 32 10 – ELECTRIC WATER COOLERS & DRINKING FOUNTAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:

A. Industry Standards:

1. Provide drinking-water coolers which have been listed and labeled by Underwriters' Laboratories (UL399)
2. Provide drinking-water coolers which are rated and certified in accordance with Air Conditioning and Refrigeration Institute (ARI) Standard 1010.
3. Provide wheelchair water coolers which comply with ANSI A117.1-2003 and ADA guidelines.
4. Provide drinking-water coolers which are manufactured using lead-free components and solder in all waterways.

1.3 SUBMITTALS:

A. Provide manufacturer's data, test reports, and product warranties as applicable.

PART 2 - PRODUCTS

2.1 ELECTRIC WATER COOLER "EWC-1":

A. Provide wall mounted wheelchair type water coolers with integral water chiller capable of delivering 7.5 gph of 50 degrees water at 90 degrees F ambient temperature and 80 degrees F entering water temperature. Units shall have hermetically sealed refrigerant system complete with 120V/1PM/60HZ compressor and air cooled condenser. Cabinet, receptor, and back shall be stainless steel. Bubbler operator shall be a soft touch vandal proof bar full across the front of the unit. The water cooler shall be fitted with cast brass p-traps, a valved 1/2" cold water supply, a NEMA5-20P rated plug with 3 feet (min.) chord, and chair carrier. Units shall be OASIS, HALSEY-TAYLOR, SUNROC or ELKAY. Chair carrier shall be J.R. Smith, Josam or Zurn.

2.2 ELECTRIC WATER COOLER “EWC-2":

A. Electric water cooler shall be the same as EWC-1 except that unit shall be provided with deck mounted sensor operated bottle filler accessory.

2.3 ELECTRIC WATER COOLER "EWC-3":

A. Provide bi-level wall mounted water coolers with single refrigeration system, capable of delivering 8 GPH of 50 degrees F water at 90 degrees F ambient and 80 degrees F entering water temperature. The unit shall be ADA compliant and have heavy gauge stainless steel cabinets, and receptor basins. The refrigeration system shall utilize an HFC refrigerant and be hermetically sealed with 115 Volt, 1 phase, 60 hertz compressor and air cooled condenser. Each basin shall have a chrome plated brass drain with removable strainer, and self-closing push button/bar which meets the ADA operating requirements. The water cooler shall be fitted with cast brass p-traps, a valved 1/2" cold water supply, a NEMA5-20P rated plug with 3 feet (min.) chord, and chair carrier. Provide with deck mounted sensor operated bottle filler accessory. Unit shall be an OASIS, HALSEY-TAYLOR, SUNROC, or ELKAY. Chair carrier shall be J.R. Smith, Josam or Zurn.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. General: Install water coolers in accordance with manufacturer's written instructions and in accordance with the National Electrical code and recognized industry practices.

B. After water coolers are mounted on wall, bolt a 1-1/2 inch steel angle bracket to bottom of unit and attach to wall. Paint to match wall.

3.2 FIELD QUALITY CONTROL:

A. Test operates installed water coolers to demonstrate compliance with the requirements.

END OF SECTION 22 32 10

SECTION 23 01 10 – MECHANICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

B. It is recognized that separate sub-contracts may be instituted by THIS CONTRACT'S GENERAL CONTRACTOR with others. It is the responsibility of THIS CONTRACT'S GENERAL CONTRACTOR to completely inform, coordinate and advise those sub-contractors as to all of the requirements, conditions and information associated with providing and installing their portion of the total job.

1.2 IMPOSED REGULATIONS:

A. Applicable provisions of the State and Local Codes and of the following codes and standards in addition to those listed elsewhere in the specifications are hereby imposed on a general basis for mechanical work. In each case, the prevailing edition shall be the current adopted edition of the state where the project is located.

1. *International Mechanical Code.*
2. *International Gas Code.*
3. *International Energy Conservation Code.*
4. *International Fire Code.*

1.3 SCOPE OF WORK:

A. Provide all labor, materials, equipment and supervision to construct complete and operable mechanical systems as indicated on the drawings and specified herein. All materials and equipment used shall be new, undamaged and free from any defects.

1.4 EXISTING SERVICES AND FACILITIES:

A. Damage to Existing Services: Existing services and facilities damaged by the Contractor through negligence or through use of faulty materials or workmanship shall be promptly repaired, replaced, or otherwise restored to previous conditions by the Contractor without additional cost to the Owner.

B. Interruption of Services: Interruptions of services necessary for connection to or modification of existing systems or facilities shall occur only at prearranged times approved by the Owner. Interruptions shall only occur after the provision of all temporary work and the availability of adequate labor and materials will assure that the duration of the interruption will not exceed

the time agreed upon.

C. Removed Materials: Existing materials made unnecessary by the new installation shall be removed, shall remain the property of the Owner and shall be stored at a location and in a manner as directed, or, if classified by the Owner's authorized representative as unsuitable for further use, shall become the property of the Contractor and shall be removed from the site.

1.5 WARRANTIES:

A. Provide manufacturer's standard printed commitment in reference to a specific product and normal application, stating that certain acts of restitution will be performed for the Purchaser or Owner by the manufacturer, when and if the product fails within certain operational conditions and time limits. Where the warranty requirements of a specific specification section exceed the manufacturer's standard warranty, the more stringent requirements will apply and modified manufacturer's warranty shall be provided. The Contractor shall provide a (2) year warranty on all parts and labor. The warranty shall begin at the Material Completion date.

1.6 PRODUCT SUBSTITUTIONS:

A. General: Materials specified by manufacturer's name shall be used unless prior approval of an alternate is given by addenda. Requests for substitutions must be received in the office of the Architect at least 10 days prior to opening of bids.

PART 2 - PRODUCTS

2.1 GENERAL MECHANICAL PRODUCT REQUIREMENTS:

A. Standard Products: Provide not less (quality) than manufacturer's standard products, as specified by their published product data. In addition to the indication that a particular product/model number is acceptable, comply with the specified requirements. Do not assume that the available off-the-shelf condition of a product complies with the requirements; as an example, a specific finish or color may be required.

B. Uniformity: Where multiple units of a general product are required for the mechanical work, provide identical products by the same manufacturer, without variations except for sizes and similar variations as indicated.

C. Product Compatibility, Options: Where more than one product selection is specified, either generically or proprietarily, selection is Purchaser's or Installer's option. Provide mechanical adaptations as needed for interfacing of selected products in the work.

D. Equipment Nameplates: Provide a permanent operational data nameplate on each item of power operated mechanical equipment, indicating the manufacturer, product name, model number, serial number, speed, capacity, power characteristics, labels of tested compliance, and similar essential operating data.

E. Locate nameplates in easy-to-read locations. When product is visually exposed in an occupied area of the building, locate nameplate in a concealed position (where possible) which is accessible for reading by service personnel.

PART 3 - EXECUTION

3.1 PRODUCT INSTALLATION, GENERAL:

A. Except where more stringent requirements are indicated, comply with the product manufacturer's installation instructions and recommendations, including handling, anchorage, assembly, connections, cleaning and testing, charging, lubrication, startup, test operation and shut-down of operating equipment. Consult with manufacturer's technical experts, for specific instructions on unique product conditions and unforeseen problems.

B. Protection and Identification: Deliver products to project properly identified with names, model numbers, types, grades, compliance labels and similar information needed for distinct identifications; adequately packaged or protected to prevent deterioration during shipment, storage and handling. Store in a dry, well ventilated, indoor space, except where prepared and protected by the manufacturer specifically for exterior storage.

C. Permits and Tests: Provide labor, material and equipment to perform all tests required by the governing agencies and submit a record of all tests to the Owner or his representative. Notify the Architect five days in advance of any testing.

END OF SECTION 23 01 10

SECTION 23 01 20 - MECHANICAL STANDARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:

A. Industry Standards: It is a general requirement that mechanical work comply with applicable requirements and recommendations of standards published by listed agencies and trade associations, except to the extent more detailed and stringent requirements are indicated or required by governing regulations.

B. Listing of Associations, Standards, and Abbreviations:

1. AGA — *American Gas Association*
   1515 Wilson Blvd.
   Arlington, VA 22209
2. AMCA — *Air Movement & Control Association*
   30 W. University Dr., Arlington Heights, IL 60004
   302/394-0150
3. ARI — *Air-Conditioning and Refrigeration Institute*
   4301 North Fairfax Drive, Suite 425, Arlington, VA 22203
   703/524-8800
4. ASHRAE — *American Society of Heating, Refrigerating & Air Conditioning Engineers, Inc.*
   1791 Tullie Circle, NE, Atlanta, GA. 30329
   404/636-8400
5. AWS — *American Welding Society, Inc.*
   2501 NW 7th St., Miami, FL 33125
   305/642-7090
6. CISPI — *Cast Iron Soil Pipe Institute*
   2020 K. St., NW, Washington, DC
   202/233-4536
7. NEBB — *National Environmental Balancing Bureau*
   1611 North Kent St.,
   Arlington, VA 22209
8. NEC — *National Electrical Code* by NFPA
9. NEMA — *National Electrical Manufacturers Association*
   1300 N 17th Street, Suite 1847
   Rosslyn, VA 22209
   703/841-3200
10. NFPA — *National Fire Protection Association*

	407 Atlantic Ave., Boston, MA 02210 617/482-8755
11. SMACNA	*Sheet Metal & Air Conditioning Contractors National Association, Inc.* 8224 Old Courthouse Rd., Tysons Corner Vienna, VA 22180 703/790-9890
12. TIMA	*Thermal Insulation Manufacturers Association* 7 Kirby Plaza Mt. Kisco, NY 10549 912/241-2284
13. UL	*Underwriters' Laboratories, Inc.* 207 East Ohio St., Chicago, IL 60611 312/642-6969

PARTS 2 AND 3 - PRODUCTS AND EXECUTION

A. Not applicable,

END OF SECTION 23 01 20

SECTION 23 02 10 - MECHANICAL COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:

A. Mechanical Coordination Plans: Prepare a set of coordination plans showing the coordination of the major elements, components and systems of the mechanical work, and showing the coordination of mechanical work with other work. Prepare plans at accurate scale and sufficiently large to show locations of every item, including clearances for installing, maintaining, insulating, breaking down equipment, replacing motors and similar requirements. Prepare plans to include plans, elevations, sections and details as needed to conclusively show successful coordination and integration of the work. Submit plans for review by the Architect/Engineer. Coordination plans shall be submitted for the following areas: All VRF piping and all roof mounted equipment.

B. Coordinate the actual location of all mechanical work visible in finished spaces with the Architect/Engineer. This includes air distribution devices, exposed ductwork, thermostats, humidistats, switches, sensors, etc.

C. Mechanical Coordination Affidavit: Prior to ordering materials, provide the Coordination Affidavit required by Section 23 0220.

PART 2 - PRODUCTS

2.1 MECHANICAL PRODUCT COORDINATION:

A. Power Characteristics: Refer to the electrical sections of the specifications and the electrical drawings for the power characteristics available for the operation of each power driven item of equipment. The electrical design was based on the typical power requirements of the equipment manufacturers scheduled or specified. Any modifications to the electrical system which are required due to the use of an approved equivalent manufacturer shall be made at no additional cost to the owner. All changes must be clearly documented and submitted for review by the Architect/Engineer prior to purchasing equipment. Coordinate purchases to ensure uniform interface with electrical work. The mechanical contractor shall furnish a detailed list of equipment electrical characteristics to the electrical contractor for the purpose of preparing the coordination affidavit required by Division 26.

B. Filters: Disposable HVAC filter shall conform to SCCPSS approved sizes. Contact SCCPSS

Facility Department for approved list.

C. Coordination of Options and Substitutions: Where the contract documents permit the selection from several product options, and where it becomes necessary to authorize a substitution, do not proceed with purchasing until coordination of interface of equipment has been checked and satisfactorily established.

D. Firestopping: Refer to architectural drawings for the locations of all fire rated ceilings, floors and walls. The contractor shall furnish detailed shop drawings of all firestopping details to be used for both piping and ductwork. All firestopping details shall be U.L. listed and subject to approval by the State Fire Marshal.

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION:

A. Substrate Examination: The Installer of each element of the mechanical work must examine the condition of the substrate to receive the work, and the conditions under which the work will be performed, and must notify the Contractor in writing of conditions detrimental to the proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

B. Do not proceed with the installation of sleeves, anchors, hangers, roof penetrations and similar work until mechanical coordination drawings have been processed and released for construction. Where work must be installed prior to that time in order to avoid a project delay, review proposed installation in a project coordination meeting including all parties involved with the interfacing of the work.

3.2 CUTTING AND PATCHING:

A. Structural Limitations: Do not cut structural framing, walls, floors, decks and other members intended to withstand stress, except with the Architect's or Engineer's written authorization.

B. Where authorized, cut opening through concrete (for pipe penetrations and similar services) by core drilling or sawing. Do not cut by hammer-driven chisel or drill.

C. Other work: Do not endanger or damage other work through the procedures and processes of cutting to accommodate mechanical work. Review the proposed cutting with the Installer of the work to be cut, and comply with his recommendations to minimize damage. Where necessary, engage the original Installer or other specialists to execute the cutting in the recommended manner.

D. Where patching is required to restore other work, because of either cutting or other damage inflicted during the installation of mechanical work, execute the patching in the manner recommended by the original Installer. Restore the other work in every respect, including the elimination of visual defects in exposed finishes, as judged by the Architect. Engage the original Installer to complete patching of the following categories of work:

1. Exposed concrete finishes and exposed masonry.
2. Waterproofing and vapor barriers.
3. Roofing, flashing and accessories.
4. Interior exposed finishes and casework, where judged by the Architect to be difficult to achieve an acceptable match by other means.

3.3 COORDINATION OF MECHANICAL INSTALLATION:

A. General: Sequence, coordinate and integrate the various elements of mechanical work so that the mechanical plant will perform as indicated and be in harmony with the other work of the building. The Architect/Engineer will not supervise the coordination, which is the exclusive responsibility of the Contractor. Comply with the following requirements:

1. Install piping, ductwork and similar services straight and true, aligned with other work and with overhead structures and allowing for insulation. Conceal where possible.
2. Arrange work to facilitate ease of maintenance and repair or replacement of equipment and filters. Locate items requiring more maintenance such as valves, etc. in front of items requiring less maintenance. Connect equipment for ease of disconnecting, with minimum of interference with other work.
3. Equipment located above ceilings shall be installed in a position and elevation which allows complete and adequate maintenance access through the ceiling grid or access panel while standing safely on a ladder. If this is not possible, a suitable maintenance platform must be provided per IMC.
4. Give the right-of way to piping systems required to slope for drainage (over other service lines). Piping shall be located to avoid interference with ductwork and light fixtures.
5. Store materials off the ground and protected from standing water and weather.

B. Drawings: Conform with the arrangement indicated by the contract documents to the greatest extent possible, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, comply with the Architect's decision on resolution of the conflict.

C. Electrical Work: Coordinate the mechanical work with electrical work, and properly interface with the electrical service. In general, and except as otherwise indicated, install mechanical equipment ready for electrical connection. Refer to electrical sections of the specifications for electrical connection of mechanical equipment.

D. Duct Smoke Detectors: In buildings equipped with a fire alarm system, all HVAC duct smoke detectors, including smoke detectors for smoke dampers, shall be furnished by Division 26 and installed by Division 23. All duct smoke detectors must be compatible with the fire alarm system and must be connected to the fire alarm system for notification. All fire alarm wiring and associated devices shall be furnished and installed by the fire alarm system installer. In buildings not equipped with a fire alarm system, all HVAC duct smoke detectors and accessories shall be furnished and installed by Division 23. Each duct smoke detector must have a remote device where actuation of the duct smoke detector shall activate a visible and an audible signal in an approved location. Duct smoke detector trouble conditions shall activate a visible or audible signal in an approved location and shall be identified as “Air Duct Detector Trouble.” Each smoke detector shall be wired into the respective fan control

circuit to automatically shut down the fan upon sensing products of combustion.

E. Utility Connections: Coordinate the connection of mechanical systems with exterior underground utilities and services. Comply with the requirements of governing regulations, franchised service companies and controlling agencies. Provide a single connection for each service except where multiple connections are indicated.

3.4 COORDINATION OF MECHANICAL START-UP:

A. Seasonal Requirements: Adjust and coordinate the timing of mechanical system start-ups with seasonal variations, so that demonstration and testing of specified performance can be observed and recorded. Exercise proper care in off-season start-ups to ensure that systems and equipment will not be damaged by the operation.

B. Painting and Air Distribution: Coordinate the initial cleaning and start-up of the air distribution system, to occur prior to preparatory cleaning and general interior painting and decorating on the project. The HVAC system should not be operated until drywall work is completed. Drywall dust must not be allowed to contaminate the interior of air handing units and ductwork. Use high efficiency temporary filters until project closeout.

END OF SECTION 23 02 10

SECTION 23 02 20 - MECHANICAL SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUBMITTAL FORMS AND PROCEDURES:

A. The purpose of submittals is to demonstrate to the Architect/Engineer that the Contractor understands the design concept. The Architect/Engineer's review of such drawings, schedules, or cuts shall not relieve the Contractor from responsibility for deviation from drawings or specifications unless he has, in writing, called the Architect/Engineer's attention to such deviations at the time of submission, and has received from the Architect/Engineer, in writing, permission for such deviations. All submittals must be completely checked by the Contractor prior to submission for review.

B. Hard Copy Submittals: Submittal data shall be placed in one or more hard-back 3-ring binders, arranged and labeled according to specification section. Each binder shall contain a title page and table of contents. Provide separator tabs, and label by specification section. Make note in the table of contents, any drawings that accompany the submittal. Title page shall contain Project Name, Contractor’s Name, Division 23 Superintendent’s name, Suppliers and point of contact for each, and date. Except as otherwise indicated in other sections, submit 5 complete copies. Quantity indicated does not include copies required for regulatory agencies.

C. Electronic Submittals: If the Architect agrees to allow electronic submittals via an on-line information management product such as “Submittal Exchange,” etc., all electronic submittal files shall be organized to match the bid documents for specification section and name. Each submittal file shall be complete for each specification section. Multiple partial submittals per specification section will be rejected. Make note in the table of contents, any drawings that accompany the submittal. Title page shall contain Project Name, Contractor’s Name, Division 23 Superintendent’s name, Suppliers and point of contact for each, and date.

D. Submittals shall be made for all items contained in the Mechanical Submittal List in PART 3 - EXECUTION.

E. Response to Submittals: A Mechanical Submittal Review Report shall be issued by the Engineer with the following classifications for each item:

1. "No Exceptions Taken": No corrections, no marks. Contractor shall submit copies for distribution.
2. "Make Corrections Noted": A few minor corrections. Items may be ordered as marked up without further resubmission. Submit copies for distribution.

3. "Revise and Resubmit": Minor corrections. Item may be ordered at the Contractor's option. Contractor shall resubmit drawings with corrections noted.
4. "Rejected": Major corrections or not in accordance with the contract documents. No items shall be ordered. Contractor shall correct and resubmit drawings.

PART 2 - PRODUCTS

2.1 SUBMITTAL REQUIREMENTS:

A. General: Each specification section shall list the required submittal items. All submittal items shall conform to the requirements listed below. For each major section of submittal data, include a summary page which lists items and model numbers for each piece of equipment.

B. Shop Drawings: Prepare mechanical shop drawings to accurate scale except where diagrammatic representations are specifically indicated. Show clearance dimensions of critical locations, and show dimensions of spaces required for operation and maintenance of equipment. Show piping connections and other service connections, and show interface with other work including structural support. Indicate by note, the portions of mechanical work shown on the shop drawings which deviated from the indication of work in the contract documents, and explain the reasons for the deviations. Show how such deviations coordinate with interfacing deviations on shop drawings for other portions of the work, currently or previously submitted.

C. Manufacturer's Data: Where pre-printed data is submitted for more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy with black pen to indicate which of the variations is to be provided. Delete or mark-out significant portions of preprinted data which are not applicable. Where operating ranges are shown, mark data to show portion of range required for project application. Expansion or elaboration of standard data to describe a non-standard product must be processed as a shop drawing submittal. For each product include the manufacturer's production specifications, installation or fabrication instructions, nearest source of supply (including telephone number), sizes, weights, speeds, operating capacities, piping and service line connection sizes and locations, statements of compliance with required standards and governing regulation (include manufacturer's signed statements if not covered in printed data), performance data (where applicable) and similar information needed to confirm compliance with the requirements.

D. ATTACHMENT NO. 1 (Mechanical Coordination Affidavit):

1. The intent of Attachment Number 1 is to ensure that the electrical requirements for mechanical equipment have been reviewed and coordinated by the Contractor. No mechanical equipment shall be ordered, nor shall rough-in begin, before this coordination has taken place. This document shall be returned appropriately marked whether or not any changes are deemed to be necessary by the contractor.

PART 3 - EXECUTION

3.1 MECHANICAL SUBMITTAL LIST:

23 0210 – Mechanical Coordination:

Mechanical Coordination Plans.
Mechanical Coordination Affidavit (see Attachment No. 1 below)

23 0230 – Mechanical Identification:

Pipe Markers.
Pipe Tape.
Engraved Nameplates.
Valve Tags.
Valve Charts.

23 0240 – Mechanical Work Closeout:

Record Plans.
Maintenance Manuals.
Mechanical TAB Report.
Owner Training Videos.

23 0310 – Mechanical Pipe, Tube, and Fittings:

Copper Tube.
PVC Pipe.
Soldering Materials.
PVC Cement.
Pipe Sleeves.
Fire Caulk.
Latex Paint for PVC Pipe.

23 0320 – Mechanical Hangers and Supports:

Refrigerant Pipe Hangers.
HVAC Drain Hangers.
Piping Roof Supports.
Pipe Portals.
Roof Equipment Support Rails.

23 1210 – Mechanical Piping and Equipment Insulation:

Armaflex Insulation and Fittings.
Aluminum Jackets.

23 2110 – Ductwork:

Duct Construction Standards.

Black Steel Ducts.
Galvanized Steel Ducts.
Stainless Steel Ducts.
Double Wall Round Spiral Seam Ducts and Fittings.
Flexible Ducts.
Fabric Ducts.
Flexible Connectors.
Manual Balancing Dampers.
Automatic Balancing Dampers.
Round Takeoff Fittings.
Rectangular Takeoff Fittings.
Fire Dampers.
Smoke Dampers.
Combination Fire/Smoke Dampers.
Access Doors.
Duct Wrap Type 'A'.
Duct Liner Type 'A'.
Duct Liner Type 'B'.
Fire Rated Duct Wrap.
Duct Insulation Accessories.
Duct Insulation Compounds.
Duct Sealant.
Duct Leakage Test Results.

23 2210 – Air Distribution:

All devices in AIR DISTRIBUTION SCHEDULE and/or plans and/or specifications.

23 2220 – Smoke Vent:

All devices on plans and/or specifications.

23 2310 – Fans:

All equipment in FAN SCHEDULE and/or plans and/or specifications.

23 2510 – Kitchen Hood Ventilation System:

All equipment in FAN SCHEDULE, MAKEUP AIR HEATER SCHEDULE and/or plans and/or specifications.

23 2740 – Modulating Building Exhaust Systems:

All equipment in noted in equipment schedules and/or plans and/or specifications.

23 3110 – Electric Heaters:

All equipment in ELECTRIC HEATER SCHEDULE and/or plans and/or specifications.

23 4320 – Air Treatment Systems:

All equipment in noted in equipment schedules and/or plans and/or specifications.

23 5310 –Air Conditioners:

All equipment in AIR CONDITIONER SCHEDULES and/or plans and/or specifications.

23 6110 – Heat Pumps:

All equipment in HEAT PUMP SCHEDULES and/or plans and/or specifications.

23 6310 – VRF Heat Pumps:

All equipment in VRF HEAT PUMP SCHEDULES, VRF AIR HANDLER SCHEDULES and/or plans and/or specifications.

23 7110 –Dedicated Outside Air Systems:

All equipment in DEDICATED OUTSIDE AIR SYSTEM SCHEDULE and/or plans and/or specifications.

23 7210 – Energy Recovery Ventilators:

All equipment in ENERGY RECOVERY VENTILATOR SCHEDULE and/or plans and/or specifications.

23 7220 – Small Energy Recovery Ventilators:

All equipment in ENERGY RECOVERY VENTILATOR SCHEDULE and/or plans and/or specifications.

23 8310 – EMCS (Energy Management Control System):

All controls equipment, sequences, control diagrams, etc. in plans and/or specifications.

23 9110 – Mechanical Sound, Vibration, Wind, and Seismic:

Wind Calculations for all roof mounted equipment.
All equipment in plans and/or specifications.

23 9210 – Mechanical TAB (Test, Adjust, Balance):

Qualifications package.
Testing procedures.
Instrument list.
Sample test forms.

END OF SECTION 23 02 20

ATTACHMENT NO. 1

SHOP DRAWING COORDINATION AFFIDAVIT

I, the Division 23 Superintendent, certify that I have reviewed the mechanical shop drawings for electrically driven equipment and that the accompanying mechanical shop drawings reflect the requirements of the actual equipment to be furnished for use on this project. In addition, the electrical requirements of said equipment have been coordinated with the Division 26 contractor.

NOTE: If no deviations are required please indicate by circling the appropriate answer above your signature.

PROJECT: _____ DEVIATIONS: Yes / No

COMPANY:_____

TITLE: _____ SIGNATURE: _____

TELEPHONE: _____DATE:_____

FAILURE TO PERFORM THE WORK REQUIRED BY THIS AFFIDAVIT, PRIOR TO ORDERING MATERIALS OR ROUGHING-IN, MAY RESULT IN IMPROPER CONNECTIONS BEING PROVIDED. THE EXPENSE OF CORRECTIVE MEASURES, IF REQUIRED, SHALL BE BORNE BY THE CONTRACTOR.

SECTION 23 02 30 - MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:

A. Manufacturers: Firms regularly engaged in the manufacture of identification systems required for this product.

B. Submittals: Submit manufacturer's data on materials and submit a sample of each type required.

PART 2 - PRODUCTS

2.1 MECHANICAL IDENTIFICATION MATERIALS:

A. Pipe Markers:

1. General: Product manufacturer's standard pre-printed, flexible or semi-rigid, permanent, color-coded, plastic-sheet pipe markers, complying with ANSI A13.1.
2. Small Pipe: For external diameters less than 6 inches (including insulation, if any), provide full band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
   a. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
   b. Adhesive lap joint in pipe marker overlap.
   c. Laminated or bonded application of pipe marker to pipe (or insulation).
   d. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4-inch-wide; full circle at both ends of pipe marker, tape lapped 1-1/2 inch.
3. Large Pipes: For external diameters of 6 inches and larger (including insulation, if any), provide either full-band or strip-type pipe markers, but not narrower than 3 x letter height (and of required length), fastened by one of the following methods:
   a. Laminated or bonded application of pipe marker to pipe (insulation).
   b. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2 inches wide: full circle at both ends of pipe marker, tape lapped 3 inches.
4. Lettering: Comply with piping system names as specified, scheduled or shown, and abbreviate only as necessary for each application length.
5. Arrows: Print each pipe marker with arrow indicating direction of flow, either integrally with piping system service lettering or as separate unit of plastic (to accommodate both directions).

6. Install pipe markers on the following systems:

   Refrigerant Piping
   HVAC Drain Piping

B. Pipe Tape: Manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.

1. Width: Provide 1-1/2 inches wide tape markers on pipes with outside diameters including insulation of less than 6 inches, 2-1/2 inches wide tape on larger pipes.
2. Color: Comply with ANSI A13.1.

C. Engraved Plastic-Laminate Labels:

1. General: Provide engraving stock melamine plastic laminated, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core, letter color, except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
2. Thickness: 1/16 inch, except as otherwise indicated.
3. Fasteners: Self-tapping stainless steel screws, except contact type permanent adhesive where screws cannot or should not penetrate the substrate.
4. Install engraved equipment labels on all mechanical equipment. Match equipment names as scheduled.
5. Install “Permanent Label of Equivalent Length” in each laundry area near the clothes dryer. Label shall match the example shown in 2018 IMC, Section 504. The contractor shall fill in the actual equivalent length for each dryer exhaust duct.

2.2 LETTERING AND GRAPHICS:

A. General: Coordinate names, abbreviations and other designations used in the mechanical identification work, with the corresponding designations shown, specified or scheduled. Provide numbers, lettering recommended by manufacturers or as required for proper identifications and operation/maintenance of the mechanical systems and equipment.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION:

A. Coordination: Where identification is to be applied to surfaces which require insulation, painting and other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering or painting.

B. All equipment, dampers, filters, valves, etc. located above ceiling grids shall be located with an engraved marker permanently attached to the ceiling grid. The marker shall describe the item located above the ceiling.

C. Piping System Identification:

a. General: Install pipe markers on each system indicated to receive identification and include arrows to show normal direction of flow.

D. Locate pipe markers as follows wherever piping is exposed to view in mechanical rooms, accessible maintenance spaces (including accessible areas above ceilings) and exterior non-concealed locations:

a. Near each valve and control device.
b. Near each branch, excluding short take-offs for fixtures. Mark each pipe at branch, where there could be a question of flow pattern.
c. Near locations where pipes pass through walls, ceilings, or enter non-accessible enclosures.
d. Near major equipment items and other points of origination and termination.
e. Spaced intermediately at maximum spacing of 50 feet along each piping run, except reduce spacing to 25 feet in congested areas of piping and equipment.

E. Do not mark piping exposed in finished occupied spaces.

F. Mechanical Equipment Identification: Install an engraved plastic laminate label on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Each label shall include the equipment name, room number and electrical panel name. Confirm installed final room numbers and electrical panel names prior to ordering labels.

END OF SECTION 23 02 30

SECTION 23 02 40 - MECHANICAL WORK CLOSEOUT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DOCUMENTATION PROCEDURES:

A. Signed Commitments: Do not proceed with transfer of mechanical plant to the Owner for operation until warranties, performance certifications and similar commitments to be signed by Contractor and other entities have been executed and transmitted to Architect (for Owner's records).

PART 2 – PRODUCTS

2.1 RECORD PLANS:

A. Explanation: Except where otherwise indicated, mechanical plans (contract plans) prepared by Engineer are diagrammatic in nature and may not show locations accurately for various components of mechanical systems. Shop drawings, including coordination plans, prepared by Contractor shall show certain portions of work more accurately to scale and location, and in greater detail.

B. General Recording Procedure: Maintain a white-print set, blue-line or black-line, of mechanical contract plans and shop drawings in clean, undamaged condition, for mark-up of actual installations which vary substantially from the work as shown. Mark-up whatever plans are most capable of showing the installed conditions accurately; however, where shop drawings are marked, record a reference note on appropriate contract drawing. Mark with erasable pencil and use multiple colors to aid in the distinction between work of separate mechanical systems. In general, record every substantive installation of mechanical work which previously is either not shown or shown inaccurately, but in any case record the following:

1. Underground and aboveground piping, both exterior and interior, drawn to scale and fully dimensioned.
2. *“Mechanical Project Record"* shall be maintained as part of the *"Project Record"* specified in Division 1.

2.2 MAINTENANCE MANUALS:

A. Organize each copy of the required system maintenance manuals to include an index followed by thumb-tab marked sections for each of the following:

1. Operating Instructions: Submit manufacturer's operating instructions for each item of mechanical equipment and supplement with additional project application instructions where necessary. Prepare and submit specific operating instructions for charging, start-up, control or sequencing of operation, phase or seasonal variations, shut-down, safety and similar operational instructions. Prepare in typewritten form in completely explained and easily understood English language
2. Emergency instructions including addresses and telephone numbers of service sources.
3. Regular system maintenance procedures including lubrication.
4. List of all filters required for each unit.
5. Spare parts listing and stocking recommendations.
6. Inspection, adjusting, rebalancing, cleaning, parts replacement, and similar maintenance instructions and recommendations, including the proper use of tools and accessories.
7. Valve schedule and control diagram for each system.
8. Manufacturer's data and test reports for each operating item in each system.
9. Manufacturer's product warranties and guarantees relating to the system and equipment items in the system.
10. Corrected or approved issues of submittal items relating to the system.

B. Bind each maintenance manual in one or more vinyl-covered, 2", 3-ring binder, plus pocket-folder type binders for folded drawings, and mark the back spine of each binder with system identification and volume number.

C. Certifications: Where specifically indicated, submit with notarized execution.

D. Test Reports: Submit test reports which have been signed and dated by the firm performing the test and prepared in the manner specified in the standard or regulation governing the test procedures as indicated.

E. Manufacturer's Product Warranties: Where pre-printed and published warranty includes substantial deviation from required warranty (as judged by the Architect or Engineer), product is automatically disqualified from use on the project, except where manufacturer prepares and issues a specific product warranty on the product, stating that it is in lieu of the published warranty, and is executed by an authorized officer, and complies with the requirements. Warranties shall comply with the requirements of individual specification section where those requirements exceed the manufacturer's standard warranty.

F. Guarantees: Where indicated as "Certified", provide guarantee which, in addition to execution by an authorized officer of each guarantor, is attested to by the Secretary of each guarantor and bears the corporate seal

2.3 MECHANICAL TEST, ADJUST, BALANCE REPORT

A. See Section 23 9210.

PART 3 - EXECUTION

3.1 CLOSEOUT PROCEDURES:

A. General Coordination: Sequence closeout procedures properly, so that work will not be endangered or damaged, and so that every required performance will be fully tested and demonstrated.

B. System Performance Test Run: At the time of mechanical work closeout, check each item in each system to determine that it is set for proper operation. With Owner's representative and Architect/Engineer present, operate each system in a test run of appropriate duration to demonstrate compliance with performance requirements. During or following test runs, make final corrections or adjustments of system to refine and improve performances wherever possible, including noise and vibration reductions, elimination of hazards, better response of controls, signals and alarms, and similar system performance improvements. Provide testing or inspection devices as may be requested for Architect's/Engineer's observation of actual system performances. Demonstrate that controls and items requiring service or maintenance are accessible. Test run shall be scheduled to coincide with Engineer's final inspection of the mechanical work.

C. Cleaning and Lubrication: After final performance test run of each mechanical system, clean system both externally and internally. Clean dirt and debris from air handling systems and install new filters. Flush piping system by operating drains and similar means, and clean strainers and traps. Lubricate both power and hand operated equipment and remove excess lubrication. Touch-up minor damage to factory painted finishes and other painting specified as mechanical work; refinish work where damage is extensive.

D. General Operating Instructions: In addition to specified training of Owner's operating personnel specified in individual mechanical sections, and in addition to preparation of written operating instructions and compiled maintenance manuals specified, provide general operating instructions for the total mechanical plant. Conduct a walk-through explanation and demonstration for orientation and education of Owner's personnel to be involved in continued operation of building and its mechanical plant.

1. Describe each basic mechanical system and how its control system functions, including flow adjustments, temperature control and similar operations.
2. Explain and point out identification system, displayed diagrams, signals, alarms and similar provisions of the work.
3. Describe basic sequencing requirements and interlock provisions for system start-up, phasing, coast-down, shut-down and seasonal operations.
4. Emphasize emergency procedures and safety provisions for protection of equipment and safety of occupants during equipment malfunction, disasters, power failures and similar unusual circumstances, and describe system limitations and precautions including weather adjustments.
5. Outline basic maintenance procedures.

E. Demonstrate what adjustments have been made and can continue to be made to reduce noise and vibration, improve system output, decrease energy consumption and similar performance improvements.

F. Point out operational security provisions, safety, unavoidable hazards and similar operator limitations. Display and conduct a "thumb-through" explanation of maintenance manuals, record drawings, meter readings and similar service items.

G. All training sessions shall be digitally recorded (audio/video) and submitted to the Owner.

H. Construction Equipment: After completion of performance testing and Owner's operating instructions and demonstrations, remove installers tools, test facilities, construction equipment and similar devices and materials used in execution of the work but not incorporated in the work.

3.2 CONTINUED SYSTEM OPERATIONS:

A. Final Acceptance: At time of substantial completion of mechanical work, Owner's operating personnel will take over operation of mechanical systems. However, until time of final acceptance, respond promptly with consultation and services on whatever operation or maintenance problems may remain or arise in continued operation of mechanical plant.

END OF SECTION 23 02 40

SECTION 23 03 10 – MECHANICAL PIPE, TUBE AND FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:

A. Industry Standards:

1. Qualify welding procedures, welders and operators in accordance with ASME B31.1 for shop and project site welding of piping work.
2. Certify welding of piping work using the *Standard Procedure Specifications* by, and welders tested under supervision of, the *National Certified Pipe Welding Bureau*.
3. Where plastic piping is indicated to transport potable water, provide pipe and fittings bearing approval label by the *National Sanitation Foundation* (NSF).

B. SUBMITTALS:

1. Submit manufacturer's data, welding certifications, test reports, and product warranties as applicable for all piping materials.
2. Grooved joint couplings and fittings shall be shown on drawings and product submittals, and be specifically identified with the applicable style number.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS:

A. General: Provide pipe and tube of the type, joint type, grade, size and weight (wall thickness or Class) indicated for each service. Where type, grade or class is not indicated, provide proper selection as determined by Installer for installation requirements and comply with governing regulations and industry standards.

B. Copper Tube: ASTM B88-89 Type (wall thickness) as indicated for each service; hard drawn temper, except as otherwise indicated. Solder for use on domestic water piping shall be lead free type.

C. Plastic Pipe:

1. PVC-WATER: ASTM D2466-88:

2.2 PIPE/TUBE FITTINGS:

A. General: Provide factory-fabricated fittings of the type, materials, grade, class and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube valve or equipment connections in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections, and with pipe manufacturer's recommendations where applicable.

B. Soldering Materials: Except as otherwise indicated, provide soldering materials as determined by the Installer to comply with installation requirements.

1. Tin-Antimony Solder: ASTM B 32, Grade 95TA.

C. Mechanical Couplings for Copper Pipe: Fittings 2"-4" size shall be wrought copper (ASTM B75 C12200 or ASTM B152 C11000 and ANSI B 16.22). Fittings 5" - 8" size shall be bronze sand casting (ASTM B584-87) or copper alloy CDA844 (81-3-7-9) (ANSI B 16.18). Fittings shall have pre-grooved ends for use with mechanical couplings of the same manufacturer. Fittings shall be manufactured to copper tubing sizes. (Flaring of tube and fitting ends to IPS dimensions is not allowed.)

D. Solvent Cement for PVC Joints: D2564-88.

E. Pipe Sleeves:

1. Iron Pipe Sleeves: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.
2. Sheet Metal Pipe Sleeves: Fabricate from galvanized sheet metal closed with lock-seam joints. For following pipe sizes provide gauge indicated: 3 inch pipe and smaller, 20 gauge; 4 to 6 inch pipe, 16 gauge; over 6 inch pipe, 14 gauge.
3. Pipe Sleeve Caulking: *3M Fire Barrier Caulk*, *STI* or *Grabber*.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. General: Install pipe, tube and fittings in accordance with recognized industry practices which will achieve permanently-leakproof piping systems, capable of performing each indicated service without piping failure. Install each run with a minimum of joints and couplings, but with adequate and accessible unions for disassembly and maintenance/ replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections, within 1/16" misalignment tolerance.

1. Comply with ASME B31.1 Code for Pressure Piping.
2. Comply with ASME B31.9 Code for Building Services Piping.

B. Locate piping runs as indicated on the drawings. Route vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown, or described by diagrams, details and notations or,

if not otherwise indicated, run piping in the shortest route which does not obstruct usable space or block access for servicing the building and its equipment. Where possible, locate insulated piping for 1.0" clearance outside insulation. Changes in direction shall be made with fittings.

C. Piping System Joints: Provide joints of the type indicated in each piping system.

D. Mechanical Coupling Joints: Square cut pipe ends and deburr. Roll-groove pipe ends to manufacturer's specifications. Lubricate gaskets completely on interior and exterior using a non-petroleum based lubricant. Slide gasket over pipe ends between grooves. Engage coupling housing into grooves and tighten until housing bolt pads are in full contact on each side of joint. For pipes 2 inches and smaller, no groove is required. Mark pipe ends for proper insertion into couplings and fittings. Engage piping into fitting to full depth, indicated by marked pipe ends. Align pipe ends, position compression tool and press trigger until assembly cycle is complete. All grooved couplings, fittings, valves and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be molded and produced by the grooved coupling manufacturer. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Grooved coupling manufacturer's factory trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools, application of groove and installation of grooved piping products. Factory trained representative shall periodically inspect the product installation. Contractor shall remove and replace any improperly installed products.

E. Soldered Joints: Solder copper tube and fitting joints where required, in accordance with recognized industry practice. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings with steel wool. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens. Use a non-corrosive paste flux and wire solder composed of 95 percent tin and 5 percent antimony.

F. Insulating (Dielectric) Nipples: Comply with manufacturer's instructions for installing nipples in a manner which will prevent galvanic action and stop corrosion where the joining of ferrous and non-ferrous piping occurs.

G. Pipe Sleeves: Install pipe sleeves of the types specified wherever piping passes through the walls, floors or structural members of the work. Provide sleeves of adequate size, accurately centered in pipe runs. Size sleeves so that piping and insulation will have free movement in the sleeve, including allowance for thermal expansion. Where insulation includes a vapor barrier covering provide sleeve with sufficient clearance for installation of vapor barrier. Install length of sleeve equal to thickness of construction penetrated, except extend floor sleeves 0.25 inches above floor finish. Provide temporary support of sleeves during placement of concrete and other work around sleeves and provide temporary closure to prevent concrete and other materials from entering pipe sleeves.

1. Sleeve Type: At interior partitions and ceilings, install sheet metal sleeves.
2. Sleeve Type: At exterior penetrations both above and below grade, install iron pipe

sleeves.

3. Sleeve Type: Except as otherwise specified, install steel pipe sleeves.
4. Caulk pipe sleeves at exterior penetrations and at other locations where indicated. Provide sufficient quantities of oakum and lead to make permanent weather-tight closure between sleeve and piping, slightly recessed at exposed surface.

H. PVC piping exposed to sunlight shall be coated with water-based latex white paint to prevent UV light degradation.

3.2 CLEANING, FLUSHING AND INSPECTING:

A. General: Clean exterior surfaces of installed piping systems of superfluous materials and prepare for application of specified coatings.

B. Flush out piping system with clean water before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items.

3.3 PIPING TESTS:

A. General: Provide temporary equipment for testing, including pump and gages. Test piping systems before insulation is installed wherever feasible, and remove control devices before testing. Test each natural section of each piping system independently, but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating.

1. Required test period is 2 hours.

B. Unless otherwise specified for specific systems, hydraulically test each pressurized piping system at 150% of operating pressure indicated, but not less than 100 psig test pressure.

C. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 5% of test pressure.

D. Repair piping systems sections which fail the required piping test, by disassembly and re-installation, using new materials to the extent required to overcome leakage. Do not use chemicals, stop-leak compound, mastics, or other temporary repair methods. Drain test water from piping systems after repair work and retesting has been completed.

END OF SECTION 23 03 10

SECTION 23 03 20 – MECHANICAL HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUBMITTALS:

A. Provide manufacturer's data, test reports, and product warranties on all items.

PART 2 - PRODUCTS

2.1 HANGERS AND SUPPORTS:

A. General: Except as otherwise indicated, provide factory-fabricated piping hangers and supports of the type specified complete with bolts and washers. Comply with the manufacturer's published product information. Size hangers and supports properly for piping and weight of the medium being transported. Provide insulation shields for all insulated piping.

B. Hangers for refrigerant lines shall be copper plated band type with adjusting nut; *Anvil* Fig. CT-69, *B-Line* Fig. B3170CT, or equivalent by *Erico Caddy*, *PHD Manufacturing* or *Hubbard Enterprises/Holdrite*.

C. Hangers for HVAC drain piping shall be the standard clevis type *B-Line* Fig. B3100 or equivalent by *Anvil*, *Erico Caddy*, *PHD Manufacturing* or *Hubbard Enterprises/Holdrite*.

D. Piping installed above a roof shall be supported on pre-fabricated, non-penetrating supports by *Pipe Pier, B-Line* or *Cooper*. Provide matching adjustable elevation kits and method for positive attachment to roof.

E. Piping roof penetrations shall be made with a factory-built pipe portal assembly with minimum 20-year warranty. The pipe portal shall be aluminum construction with removable lid, UV protected powder coating, full thermal break interior with gaskets and insulation, stainless steel fasteners and exit seal locater/starter dimples. The roof curb shall be aluminum construction with full thermal break interior. Exit seals shall be injection molded ABS. All pipe penetrations shall be through housing walls, not the lid. Select housing size in accordance with number of pipe penetrations needed. Pipe portal shall be by *Alta, Roof Penetration Housings,* or approved equal by Owner.

F. Equipment rails for roof mounted equipment shall be 18 gauge galvanized steel construction

with integral base plate, continuous welded corner seams, pressure treated wood nailer and counterflashing with screws. Equipment support rails shall be by *Aladdin, Pate, Thybar* or *RPS*.

PART 3 - EXECUTION

3.1 HORIZONTAL PIPING SUPPORT:

A. Minimum spacing of hangers and supports for above-ground horizontal pipe and tubing shall be as follows:

1. Copper Tubing:

Tubing Size (inches)	Support Spacing (feet)
3/4 and smaller	5
1 to 2-1/2	6
3	10
4 and larger	12

2. Plastic Pipe:

Nominal Pipe Size (inches)	Support Spacing (feet)
3/4	3.0
3/4 to 1	3.5
1-1/4 to 1-1/2	4.0
2 to 2-1/2	4.5
3 and larger	5.5

B. Prevent electrolysis in the support of copper tubing by the use of hangers and supports which are copper plated, or by other recognized industry methods.

C. Branch piping located in walls, partitions or pipe chases shall be rigidly supported inside the wall or chase.

3.2 VERTICAL PIPING SUPPORT:

A. Plastic Piping: Support at 8 feet maximum intervals and near each joint.

B. Copper Tubing: Support at riser tops and 5 feet maximum on center for pipe 1-1/2” and larger and 4 feet on center for pipe 1-1/4” and smaller. Use copper plated pipe clamps.

3.3 ADJUSTMENT OF HANGERS AND SUPPORTS:

A. Adjust hangers and supports to bring piping to proper level, elevations and slopes.

END OF SECTION 23 03 20

SECTION 23 12 10 – MECHANICAL PIPING AND EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SCOPE:

A. Piping and equipment to be insulated include:

1. HVAC Drain Piping
2. Refrigerant Piping

1.3 QUALITY ASSURANCE:

A. Manufacturers: Provide insulation products produced by one of the following for each type and temperature range of insulation.

1. *Certainteed*
2. *Knauf*
3. *Manville*
4. *Owens-Corning*
5. *Pittsburgh Corning*
6. *Armacell*
7. *Aeroflex USA*
8. *K-Flex USA*

B. Flame/Smoke Ratings: Provide composite piping insulation (insulation, jackets, covering, sealers, mastics and adhesives) with flame-spread rating not exceeding 25 and smoke developed rating not exceeding 50, as tested by ASTM E 84 (NFPA 255) method and UL 723.

1.4 SUBMITTALS:

A. Provide manufacturer's data, test reports, and product warranties for all items.

PART 2 - PRODUCTS

2.1 PIPE INSULATION:

A. Fiberglass Insulation: Insulation shall be preformed, two-piece, heavy density fiberglass with self sealing ASJ jacket conforming to ASTM C 547. Insulation on elbows and fittings shall be pre-formed fiberglass with PVC covers and same material thickness as adjacent pipe. Insulation thickness shall be as follows:

1. HVAC Drain Piping: 1 inch thick for all sizes.

B. Closed Cell Elastomeric Insulation: Closed cell elastomeric glass insulation shall comply with ASTM C 534, Type I, Tube Grade 1. Jacketing for outdoor applications shall be .016 inch aluminum. Insulation on valves, elbows and fittings shall be pre-formed closed cell elastomeric with same material thickness as adjacent pipe. Insulation thickness shall be as follows:

1. HVAC Drain Piping: 1 inch thick for all sizes.
2. Refrigerant Piping: Per equipment manufacturer’s recommendations.

C. Aluminum Jacket: Corrugated, embossed or smooth sheet, .016 inch nominal thickness, ASTM B 209, temper H14, type 3003, 5005 or 5010.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING INSULATION:

A. General: Install insulation products in accordance with the manufacturer's written instructions, and in accordance with recognized industry practices to ensure that the insulation serves its intended purpose. Do not use cut pieces or scraps abutting each other.

B. Insulation shall be applied on clean dry surfaces. All insulation shall be continuous through wall and ceiling openings and sleeves. Insulation on all cold surfaces, where vapor barrier jackets are used, will be applied with continuous unbroken vapor seal. Seal off ends of insulation on cold piping systems with white vapor barrier coating aT supports and exposed ends. Supports that are secured to cold surfaces shall be insulated and vapor sealed to prevent condensation.

C. Pipe covering protection shields shall be provided around exterior of pipe insulation at pipe hangers which fit around pipe insulation. Shields shall be 12 inches long by 180 degrees and shall be 18 gauge galvanized steel sheet. High density isolation inserts shall be provided at pipe saddles.

D. Unions shall not be insulated.

E. Cover fittings and similar items in each piping system.

F. Extreme care shall be taken to insure a neat, uniform exterior surface on insulation applied to exposed pipes. Insulation in finished areas shall be painted in accordance with the paint specifications.

G. Aluminum jackets shall be provided on exterior insulated pipes where noted on the plans.

3.2 PROTECTION AND REPLACEMENT:

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

B. Protection: The Installer of the insulation shall advise the Contractor of required protection for the insulation work during the remainder of the construction period, to avoid damage and deterioration.

END OF SECTION 23 12 10

SECTION 23 21 10 - DUCTWORK AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:

A. Industry Standards:

1. Comply with SMACNA *(Sheet Metal and Air Conditioning Contractor's National Association)* recommendations for fabrication, construction and details and installation procedures, except as otherwise indicated.
2. Comply with ASHRAE *(American Society of Heating, Refrigerating and Air Conditioning Engineers)* recommendations, except as otherwise indicated.
3. Provide composite ductwork insulation (insulation, coverings, sealers, mastics and adhesives) with flame-spread rating of 25 or less and a smoke-developed rating of 50 or less, as tested by ASTM E84 (NFPA 255) method.
4. Provide duct connectors which comply with applicable portion of UL 181 and bear label of *Underwriter's Laboratories*.

1.3 SUBMITTALS:

A. Provide manufacturer's data, test reports, and product warranties as applicable for all items.

PART 2 - PRODUCTS

2.1 ABOVE GROUND DUCTWORK:

A. General: Galvanized steel ductwork shall be used for all supply, return, exhaust, and ventilation ducts except as indicated otherwise by the contract documents. Preinsulated flexible duct shall be used to make final concealed connections to diffusers, registers, and grilles. Length of flexible duct shall not exceed five feet.

B. Galvanized Steel Ductwork: Ducts shall be fabricated from G90 galvanized sheet steel complying with ASTM A653, lock-forming quality. Concealed round ducts shall be the spiral seam type or snap-lock type with matching fittings. Round supply ducts which are exposed shall be the double wall spiral seam type with solid inner wall, 1” thick internal insulation with matching fittings and paint grip finish.

C. Flexible Ducts: Flexible ducts shall be U.L. Listed as Class 1 Flexible Air Duct Material and shall comply with NFPA Standards 90A and 90B. Duct shall be a factory fabricated assembly composed of a polymeric liner duct bonded permanently to a coated spring steel wire helix and supporting a fiberglass insulating blanket with a minimum R-value of 4.2. Low permeability outer vapor barrier of fiberglass reinforced film laminate shall complete the assembly. Duct shall be suitable for low and medium pressure systems and shall carry a full 5-year warranty. For all flexible duct connections to diffusers, registers and grilles, provide rigid elbow brace accessory with one duct diameter centerline radius. Flexible duct shall be by *Atco*, *Flexmaster*, *Genflex* or *Thermaflex*.

2.2 DUCTWORK ACCESSORIES:

A. General: Except as otherwise indicated for each ductwork accessory, provide metal type, gauge, weight, construction and reinforcing as required by size limitations, and applicable SMACNA standards, including fittings, supports and appurtenances.

B. Flexible Connectors: Provide flexible connectors between supply and return duct connections to equipment and as otherwise indicated on the drawings. Flexible connector shall be constructed of neoprene permanently attached to 3” wide metal bands. Connector shall be UL listed and shall be by *Durodyne*, *Ventfabrics, Cain* or *Ductmate*.

C. Manual Balancing Dampers: Provide single blade dampers for round ducts and rectangular ducts less than 12” as indicated on the drawings. Dampers shall be constructed of galvanized steel. Damper shall be installed complete with locking quadrants. For rectangular ducts 12” and wider, provide opposed-blade type dampers constructed of galvanized steel mounted in a galvanized steel channel frame. Blade spacing shall not exceed 6” and the top and bottom edges of the blades shall be crimped to stiffen the blades. Damper blades shall be interconnected by rods and linkages to provide simultaneous operation of all blades. Damper shall be provided with an extended rod to permit installation of a damper regulator. Dampers shall be by *Air Balance*, *Arrow*, *Dowco*, *Jer-Air*, *Nailor, National Controlled Air*, *Ruskin*, *Phillips-Aire*, *Safe-Air* or *United*.

D. Automatic Balancing Dampers: Automatic balancing dampers shall be suitable for supply and exhaust applications and shall respond automatically to changes in duct pressure without the need for a power supply. Dampers shall be tested, rated and labeled in accordance with the latest edition of UL Standard 2043 for heat and visible smoke release and UL Standard 555 for fire. Each damper assembly shall be UL rated and approved. Dampers shall incorporate a hand-operated manual set point adjustment feature that allows for field adjustment without the use of tools. All set points shall operate within +/- 10% of airflow set point. Individual set points shall be laboratory calibrated and tested in accordance with AMCA 500-D-12. Damper frame and blades shall consist of reinforced UL 94 thermoplastic resins, infused with anti-microbial agent. Bearings shall be hydraulic blsde dampener. Outer damper seal shall be removeable rubber gasket around damper circumference. Damper spring shall be stainless steel leaf type. Dampers shall be rated for pressures from 0.2” to 2.0” wg, airflow from 25 cfm – 275 cfm, and temperatures from 25 F – 150 F. Provide the following accessories where noted on the plans: flanged wall sleeve, wall grille, UL 555 rated 1 ½ or 3 hour static fire damper, adaptor ring. Dampers shall be by *Greenheck, Ruskin* or *Automatic Airflow Balancing.*

E. Round Take-Offs: Round take-offs shall be made using collars constructed of galvanized steel equipped gasket flange and manual balancing damper with 2" handle standoff. Do not furnish extractors or air scoops. Takeoffs from medium pressure ducts to air terminal units shall have a conical entry. Take-offs from low pressure rectangular trunk ducts shall have 45° entry. Takeoffs shall be by *Celcon*, *Crown*, *Flexmaster*, *Jer-Air*, *Metalcraft*, *Sheet Metal Connectors*, *Thermaflex* or *United*.

F. Rectangular Take-Offs: Rectangular take-offs shall be made using collars constructed of galvanized steel equipped with gasket flange and manual balancing damper with 2" handle standoff. Do not furnish extractors or air scoops. All takeoffs shall have 45° entry. Takeoffs shall be by *Celcon*, *Crown*, *Flexmaster*, *Jer-Air*, *Metalcraft*, *Sheet Metal Connectors*, *Thermaflex* or *United*.

G. Fire Dampers (Walls and Floors): Provide curtain type, hinged blade, vertical and/or horizontal mounting fire dampers, suitable for duct penetration or opening protection as required on the drawings. Style 'A' dampers shall be used at wall register/grille locations. Style 'B' dampers shall be used at duct penetrations. Dampers shall meet the requirements of NFPA 90A and UL-555. Frame shall be minimum 20 gauge galvanized steel with 165°F fusible link. Blades shall be minimum 24 gauge galvanized steel. Dampers shall be by *Air Balance*, *Greenheck*, *Nailor*, *National Controlled Air*, *Phillips-Aire*, *Prefco*, *Ruskin*, *Safe-Air* or *United*.

H. Fire Dampers (Ceilings): Provide butterfly type, hinged blade, radiation fire dampers suitable for ceiling opening protection as required on the drawings. Dampers shall meet the requirements of NFPA 90A and UL-555. Frame shall be minimum 20 gauge galvanized steel with 165°F fusible link. Blades shall be minimum 22 gauge galvanized steel with UL Classified insulation. Lay-in diffusers installations shall also be equipped with UL Classified insulating blanket. Dampers shall be by *Air Balance*, *Greenheck*, *Nailor*, *National Controlled Air*, *Phillips-Aire*, *Prefco*, *Ruskin*, *Safe-Air* or *United*.

I. Duct Access Doors: Duct access doors shall be provided at all fire dampers, smoke dampers, combination fire/smoke dampers, and at control items mounted within ducts. Access doors shall be the double-wall insulated type constructed of galvanized steel not less than 24 gauge for the door and 22 gauge for the frame. Insulation shall be 1 inch thick and shall be rigid and self-sealing. Doors shall have cam locks on at least two sides. Frame shall have knockover edges for attachment to duct by preening and a vinyl gasket shall be provided between duct and frame. Doors shall be as large as possible and as close as possible to the item served. Door shall be by *Air Balance*, *Greenheck*, *Nailor*, *National Controlled Air*, *Phillips-Aire*, *Prefco*, *Ruskin*, *Safe-Air* or *United*.

J. Dryer Box: Residential clothes dryer exhaust shall discharge into a UL Classified dryer box recessed in the wall behind the dryer. Box shall be 22 gauge aluminized steel with depth suitable for wall thickness. Box shall have extension rim, mounting holes, tapered sides, paintable surface and 4" exhaust duct opening. Dryer box shall be by *In-O-Vate Technologies* or equal approved by the Engineer.

K. Flexible Duct Elbow Support: Support shall be a radius forming composite polymer brace designed to form flexible duct into a 90° elbow. Support shall be UL approved for use in a return air plenum and sized to accommodate 4" to 16" flexible ductwork. Support shall be by *FlexRight*, *Thermaflex*, *Titus*, *Malco*, or *ThermoFlo*.

2.3 DUCTWORK INSULATION:

A. General: Refer to the mechanical plans for duct insulation types and locations. Insulation shall be by *Certainteed*, *Knauf*, *Manville, Manson,* or *Owens Corning*.

B. Duct Wrap: Type "A" Duct wrap shall be 2" thick, 0.75 pcf density, blanket type fiberglass insulation with vapor barrier and minimum R-Value of 6.7.

C. Duct Liner: Internal insulation for exposed single wall spiral seam ductwork shall be 1" thick elastomeric foam insulation with minimum R-Value of 4.2 for single wall spiral seam ducts (AP/Spiralflex or equal).

D. Ductwork Insulation Accessories: Provide mechanical fasteners as recommended by the insulation manufacturer.

E. Ductwork Insulation Compounds: Provide cement, adhesives, wire wrap, coatings, sealers, protective finishes, and similar compounds as recommended by the insulation manufacturer for the applications indicated.

2.4 MISCELLANEOUS MATERIALS:

A. General: Provide miscellaneous materials and products of the types and sizes indicated and where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.

B. Duct Sealant: Duct Sealant for above ground ductwork shall be a mastic suitable for the pressure classification in accordance with SMACNA *HVAC Duct Construction Standard*". All joints and seams shall be sealed.

C. Ductwork Support Materials: Provide hot-dipped galvanized steel rods, fasteners, anchors, straps, angles and trim for support of ductwork. Wires shall not be acceptable. Ductwork installed above a roof shall be supported on pre-fabricated, non-penetrating supports by *Pipe Pier* or approved equal. Provide matching adjustable elevation kits.

D. Weatherproof Duct Sealing: Ductwork exposed outside shall be completely covered by pre-fabricated self-adhering, sheet-type protective membrane suitable for metal ductwork and thermal insulation. The outer layer shall be an embossed UV-resistant aluminum weathering surface. All longitudinal and circumferential joints shall be lapped and securely sealed. Alternatively, insulate exterior ductwork with "Techna-Duc" pre-manufactured, interlocking, insulated panel system by *PTM Manufacturing* or equal.

2.5 DUCT FABRICATION:

A. Shop fabricate ductwork in 4', 8', 10' or 12' lengths, unless otherwise indicated or required to complete runs. Pre-assemble in the shop to the greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to the extent necessary for shipping

and handling. Match-mark sections for re-assembly and coordinated installation.

B. Fabricate ductwork with joints, seams and reinforcements as required in the latest edition of SMACNA *HVAC Duct Construction Standards*, 2" static pressure rating.

C. Fabricate duct fittings to match adjoining ducts and to comply with duct requirements as applicable to fittings. Elbows shall be either the curved radius type or the square type with turning vanes. Curved radius elbows shall have a centerline radius equal to 1.5 times the duct width. Curved radius elbows with square throats shall not be acceptable.

D. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Where ducts are specified to lined, make allowances for the thickness of the liner. Duct sizes shown on the drawings are clear, inside dimensions.

E. Kitchen hood exhaust ductwork, dishwasher exhaust ductwork and fume hood exhaust ductwork joints and seams shall have liquid-tight continuous external weld per NFPA-96.

PART 3 - EXECUTION

3.1 INSTALLATION OF DUCTWORK:

A. General: Assemble and install ductwork in accordance with the latest edition of SMACNA *HVAC Duct Construction Standards* and with recognized industry practices which will achieve air tight noiseless systems, capable of performing each indicated service. Install each run with a minimum of joints. Align ductwork accurately at connections, and with internal and external surface smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of the type which will hold ducts true-to-shape and prevent buckling. Hanger locations shall be coordinated with the building structure and finish conditions.

B. Complete fabrication of work at the project as necessary to match shop fabricated work and accommodate installation requirements.

C. Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by plans, diagrams, details and notations or, if not otherwise indicated, run ductwork in the shortest route which does not obstruct usable space or block access for servicing the building and its equipment. Coordinate the layout with piping, lighting layouts and similar finished work and plumbing risers. Duct layouts shown are diagrammatic and actual location of duct shall be field verified and coordinated by the duct fabricator prior to beginning fabrication of duct systems.

D. Duct collars shall be provided where ducts pass through walls and partitions which extend full height to the underside of the roof structure. Collars shall be fabricated from 22 gauge galvanized steel sheet. Duct collars shall be provided on both sides of walls and partitions, except collar shall be omitted on that side of the wall where registers and grilles are installed. Flanges shall be installed tight against the wall. The space between the duct and the wall shall be packed with mineral wool.

E. Coordinate duct installations with installation of accessories, dampers, equipment, controls

and other associated work of the ductwork system.

F. Route kitchen hood and dishwasher exhaust ductwork as directly as possible. Horizontal ductwork must slope minimum ¼" per foot to drain toward the hoods. Do not create dips and traps which can collect residue. Branch ducts bottoms must connect flush to main duct bottoms. Provide NFPA-96 removable duct access doors every twelve feet and at changes in direction. Access doors shall be sized to permit duct cleaning. Conform to NFPA-96 for locations and installation details. At each exhaust fan, install an approved flexible duct connection.

3.2 INSTALLATION OF INSULATION:

A. Duct Wrap: Wrap shall be wrapped around duct work with all circumferential joints butted and longitudinal joints overlapped a minimum of 2". Adhere insulation to duct with 4" strips of fire resistant adhesive at 8" on centers. On circumferential joints, the 2" flange on the facing shall be taped with minimum of 3" wide foil reinforced *Kraft* tape. On longitudinal joints the overlap shall be taped with a minimum 3" wide foil reinforced Kraft tape. On ends of insulation use 3" wide foil reinforced *Kraft* tape to fasten insulation ends to duct. For duct widths 24" and greater, provide additional mechanical fasteners on 18" centers on the bottom of the duct to prevent sagging. Insulate that part of the supply diffusers above the ceiling so that there is no uncovered metal surface subject to condensation. Provide taped-on 12"x12" squares of insulation over damper regulators located above ceilings. All duct wrap shall also be wrapped with wire. All duct insulation installed on duct exterior shall have joints and seams taped and covered with mastic, including connections to equipment.

3.3 CLEANING AND PROTECTION:

A. Clean ductwork internally, unit-by-unit as it is installed, of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of the metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.

B. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at the time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent the entrance of dust and debris.

END OF SECTION 23 21 10

SECTION 23 22 10 - AIR DISTRIBUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:

A. *Titus* is the Basis of Design manufacturer for grilles, registers and diffusers. Equivalent equipment by *Carnes, Krueger, Metalaire, Nailor, Price* and *Tuttle & Bailey* that meets performance, capacity, space and other requirements of the design documents shall be acceptable.

B. *Greenheck* is the Basis of Design manufacturer for louvers. Equivalent equipment by *Airolite, Nailor, Pottorff, Ruskin* and *United Enertech* that meets performance, capacity, space and other requirements of the design documents shall be acceptable.

C. Industry Standards: Comply with *National Fire Protection Association* Standard No. 90A, as applicable to construction and installation of required devices.

1.3 SUBMITTALS:

A. Provide manufacturer's data, test reports, and product warranties for all items as applicable.

B. Provide standard color selection charts for all air distribution devices. All colors shall be selected by the Architect during Submittal Review.

PART 2 - PRODUCTS

2.1 GRILLES, REGISTERS, AND DIFFUSERS:

A. Ceiling Diffusers: Square ceiling diffusers shall be the plaque face type with round neck and one-way, two-way, three-way, or four-way throw as indicated. Diffusers shall be of stamped aluminum construction. Provide T-bar lay-in frame for grid ceilings. Provide radial blade damper. Provide manufacturer’s molded backpan R-6 insulation.

B. Wall Registers: Registers shall be double deflection type complete with opposed blade dampers. Registers shall be of extruded aluminum construction with horizontal front blades on 3/4 inch centers.

C. Ceiling Return/Exhaust Grilles and Registers: Eggcrate grilles and registers shall be all aluminum construction with ½" square eggcrate louvers, 1" deep. All 1'x2', 2'x2', and 2'x4' grilles in lay-in ceilings shall be the lay-in type. All other sizes shall have a flanged frame. Registers shall have an opposed blade damper.

D. Wall Return/Exhaust Grilles: Horizontal fixed-blade grilles shall be of extruded aluminum construction with 45 degrees blades on 3/4 inch centers.

2.2 LOUVERS:

A. Hurricane Louvers - Horizontal: Louvers shall be AMCA 550 Listed (high velocity rain resistant with blades fully open) and AMCA 540 Listed (wind-borne debris regions). Louvers shall be approximate 50% free area, constructed of minimum 0.08-inch thick extruded aluminum, minimum 5-inch deep, with a full jamb section and channel frame. Front blades shall be horizontal J-style on approximate 2-inch spacing and back blades shall be rain-resistant vertical type on approximate 1-inch spacing. Provide a removable aluminum ½-inch mesh bird screen or 16x18 mesh insect screen (as scheduled) on the inside face of the louver. Finish shall be a factory applied primer suitable for field painting.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. General: Install devices as detailed on the drawings and in accordance with manufacturer's written instructions and in accordance with recognized industry practices.

B. Coordinate with other work, including ductwork and ductwork accessories and ceiling system as necessary to interface installation of grilles and diffusers properly with other work.

C. Ceiling mounted devices to be installed in lay-in tile ceilings shall be compatible with 24"x24" or 24"x48" T-bar grid as applicable. Refer to Architectural Reflected Ceiling Plans for exact locations of grilles, registers and diffusers. For flush mounted devices in T-bar ceilings, special care shall be taken to install devices in the center of ceiling tiles. Sagging will not be permitted. Provide rear sheet metal angle bracing.

END OF SECTION 23 22 10

SECTION 23 2310 - FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:

A. *Greenheck* is the Basis of Design manufacturer unless noted otherwise. Equivalent name brand equipment manufactured by *Acme, Carnes, Cook, Penn, Stanley* and *Twin City* that meets performance, capacity, space and other requirements of the design documents shall be acceptable.

B. Industry Standards:

1. Provide fans which bear *Air Movement and Control Association* (AMCA) certified performance rating seals.
2. Provide fan components which have been listed and labeled by *Underwriters' Laboratories*.
3. Comply with applicable portion of *National Electrical Manufacturer's Association* standards for motors.

1.3 SUBMITTALS:

A. Provide manufacturer's data, test reports, and product warranties on all items.

PART 2 - PRODUCTS

2.1 ROOF CENTRIFUGAL EXHAUST FANS:

A. Provide roof mounted centrifugal fans of the size and type as scheduled on the drawings. Fans shall be constructed with watertight housing and shall be direct or belt-driven as indicated. Motor shall be in a compartment out of the air stream. Housings shall be minimum 16 gauge spun aluminum. Fan wheel shall be of aluminum, dynamically and statically balanced, non-overloading backward-curved blades mounted on steel shaft. Equip with self-aligning heavy-duty bearings designed for end thrust and lubricated for a minimum of 10 years usage at operating temperatures of -65 to 100 degrees F. Provide vibrationless lubricated ball bearing motor with integral thermal overload protection and electrical disconnect switch under ventilator cap.

B. Provide ECM motor, aluminum bird screen and backdraft dampers. Provide matching roof curbs suitable for the roof slope. Curbs shall extend minimum 8 inches above roof surface. Fans shall be capable of resisting wind loads specified in 239110.

2.2 INLINE CENTRIFUGAL FANS:

A. Provide an inline centrifugal fan of the size and type as scheduled on the drawings. Fan housing shall be heavy-gauge painted steel. Fans shall be direct or belt-driven as indicated with aluminum centrifugal wheels with backwardly inclined, non-overloading blades. Inlets shall be deep spun for nonturbulent entrance. Provide a 100% gasketed panel to permit access to interior, and provide an internal terminal box mounted on the exterior.

B. Provide ECM motor, disconnect switch, backdraft damper and hanger brackets with vibration isolators.

PART 3 - EXECUTION

3.1 INSTALLATION OF FANS:

A. General: Except as otherwise shown or specified, install fans in accordance with manufacturer's written instructions and in accordance with National Electrical Code (NEC) and recognized industry practices.

B. The mounting height of each wall mounted thermostat or temperature sensor shall comply with ADA for maximum side reach. The thermostat or sensor shall be at 48” maximum above the floor.

3.2 TESTING:

A. After installation of fans has been completed, test each unit to demonstrate proper operation at performance requirements specified, including, but not limited to, proper rotation of impeller. When possible, field correct malfunctioning units, then retest to demonstrate compliance. Replace units which cannot be satisfactorily corrected.

END OF SECTION 23 2310

SECTION 23 31 10 - ELECTRIC HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:

A. *QMark* is the Basis of Design manufacturer. Equivalent name brand equipment by *Berko, Chromalox, Markel, Neptronic, Reddi, Raywall* and *Warren* that meets performance, capacity, space and other requirements of the design documents shall be acceptable.

B. Industry Standards: Each unit shall be U.L. listed.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT:

A. Wall Heaters: Wall heaters shall be the surface mounted fan-forced type. Provide accessory mounting kits as applicable. The heating section shall consist of a steel chassis with heating element, fan and motor, fan control, thermostat, and thermal cutout. Heater section shall be completely prewired. The element shall be the fin-tube type enclosed in a steel sheath. The fan motor shall be impedance protected, permanently lubricated type totally enclosed motor. Fan control shall be bi-metallic, snap-action type delay switch. Thermal cutout shall also be bi-metallic, snap-action type. The front cover shall be heavy gauge steel with a baked enamel finish. Heaters shall have built-in thermostat and disconnect switch.

B. Unit Heaters: Unit heaters shall be the propeller fan, horizontal discharge type with adjustable louvers. Heating elements shall be the fin-tube type with steel sheath. Cabinet shall be heavy gauge steel with baked enamel finish. Provide bracket for wall mounting. Motor and fans shall be direct drive. Motors shall be the permanently lubricated, resiliently mounted, totally enclosed type with a thermal overload protection with automatic reset. Provide low voltage transformer for connection to remote thermostat. Provide built-in fan delay switch and disconnect switch. Thermostat to be provided by controls contractor.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install heaters in accordance with the manufacturer's instructions.

END OF SECTION 23 31 10

SECTION 234320 - AIR TREATMENT SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 REFERENCED CODES & STANDARDS:

A. The following codes and standards are referenced throughout. The edition to be used is that currently enforced by the Authority Having Jurisdiction (AHJ) or in absence of such direction that referenced by the current enforceable *IMC* code or as indicated by the contract documents, except where specifically referenced by this section of the specifications.
   1. *ASHRAE Standards 62* and *52*.
   2. *National Electric Code NFPA 70*.
   3. *UL 867* including ozone chamber test.

1.3 QUALITY ASSURANCE:

A. *Global Plasma Solutions* is the Basis of Design manufacturer. Equivalent name brand systems manufactured by *BioClimatic* and *Phenomenal Aire* that meets performance, capacity, space, and other requirements of the design documents shall be acceptable.

B. A qualified representative from the manufacturer shall be available to inspect the installation of the air treatment system to ensure installation in accordance with manufacturer's recommendations.

C. Technologies that do not address gas disassociation such as UV lights, powered particulate filters and/or polarized media filters shall not be considered. Uni-polar ion generators shall not be acceptable. “Plasma” particulate filters shall not be acceptable.

D. Projects designed using *ASHRAE Standard 62, IAQ Procedure* shall require the manufacturer to provide Indoor Air Quality calculations using the formulas within *ASHRAE Standard 62.1* to validate acceptable indoor air quality at the quantity of outside air scheduled with the technology submitted. The manufacturer shall provide independent test data on a previous installation performed within the last two years and in a similar application, that proves compliance to *ASHRAE 62.1* and the accuracy of the calculations.

E. Air Treatment Systems shall have been tested by *UL* or *Intertek/ETL* to prove conformance to *UL 867-2007* including the ozone chamber testing and peak ozone test for electronic devices. Manufacturers that achieved *UL 867* prior to December 21, 2007 and have not been tested in accordance with the newest *UL 867* standard with the ozone amendment shall not be acceptable. All manufacturers shall submit their independent *UL 867* test data with ozone

results to the engineer during the submittal process. All manufacturers shall submit a copy with their quotation. Contractors shall not accept any proposal without the proper ozone testing documentation.

F. The maximum allowable ozone concentration per the *UL 867-2007* chamber test shall be 0.007 ppm. The maximum peak ozone concentration per the *UL 867-2007* peak test as measured 2" away from the electronic air cleaner output shall be no more than 0.0042 ppm. Manufacturers with ozone output exceeding these ozone values shall not be acceptable.

1.4 SUBMITTALS:

A. Provide manufacturer's data, test reports, and product warranties. The following information shall be included in the submittal:
   1. Schedule of air treatment systems indicating unit designation and number of each type required for each unit/application.
   2. Data sheet for each type of air treatment systems and accessories furnished indicating construction, sizes, and mounting details.
   3. Performance data for each type of air treatment system furnished.
   4. Indoor Air Quality calculations using the formulas within *ASHRAE Standard 62.1* to validate acceptable indoor air quality at the quantity of outside air scheduled.
   5. Product drawings detailing all physical, electrical and control requirements.
   6. Copy of *UL 867* independent ozone test.
   7. Operating and Maintenance Data: Submit O&M data and recommended spare parts lists.

1.5 WARRANTY:

A. Equipment shall be warranted by the manufacturer against defects in material and workmanship for a period of eighteen months after shipment or twelve months from Owner acceptance, whichever occurs first. Labor to replace equipment under warranty shall be provided by the Owner or installing contractor.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT:

A. General: Air Treatment Systems shall be the needlepoint bipolar ionization type. Provide an air treatment system for every HVAC unit scheduled on the plans unless noted otherwise on the plans.

B. The Bipolar Ionization system shall be capable of:
   1. Effectively killing microorganisms downstream of the bi-polar ionization equipment (mold, bacteria, virus, etc.).
   2. Controlling gas phase contaminants generated from human occupants, building structure and furnishings.
   3. Reducing static space charges.

4. Increasing the interior ion levels, both positive and negative.
5. Self-cleaning requiring no maintenance or replacement parts (where specified).
6. Producing the specified minimum ions/cc.
7. When mounted to the air entering side of a cooling coil, keep the cooling coil free from pathogen and mold growth.
8. All manufacturers shall provide documentation by an independent *NELEC* accredited laboratory that proves the product has minimum kill rates for the following pathogens given the allotted time and in a space condition:
   a. MRSA - >96% in 30 minutes or less
   b. E.coli - > 99% in 15 minutes or less
   c. TB - > 69% in 60 minutes or less
   d. C. diff - >86% in 30 minutes or less
   e. Noro Virus -> 93% in 30 minutes or less
   f. Legionella -> 99% in 30 minutes or less
   g. SARS-CoV-2 >99% in 30 minutes or less
   h. Human Coronavirus 229E – >90% in 60 minutes or less
   i. Staphylococcus – >96% in 30 minutes or less

C. Air Treatment Systems shall operate in a manner such that equal amounts of positive and negative ions are produced. Unipolar ion devices shall not be acceptable. Air exchange rates may vary through the full operating range of a constant volume or VAV system. The quantity of air exchange shall not be increased due to requirements of the system. The air treatment system shall not have a maximum velocity profile.

D. Air Treatment Systems shall not require preheat protection when the relative humidity of the entering air exceeds 85%. Relative humidity from 0-100% shall not cause damage, deterioration, or dangerous conditions within the systems. Air treatment systems shall be capable of wash down duty.

E. Dual Electrode Air Treatment Systems Up To 2,400 cfm (Basis of Design is *GPS-CI-2*):
   1. Where so indicated on the plans and/or schedules, air treatment systems shall be supplied and installed. The mechanical contractor shall mount the systems and wire to the HVAC unit control power (24VAC) or EMCS low voltage power per the manufacturer's instructions or line voltage subject to power available. Each system shall be designed with a molded casing, automatic self-cleaning system, self-cleaning test button, power status LED and dry contacts to prove ion output is operating properly. The dry contacts shall close to prove the ion generator is working properly and may be daisy chained in series such that only one dry contact per HVAC unit is required to interface to the EMCS or the optional DDC controller. Dry contacts proving power has been applied in lieu of the ion output operating are not acceptable. Manufacturers providing multiple ion modules that have alarm status wired in parallel, and not in series, shall not be acceptable.
   2. Each system shall include the required number of electrodes and power generators sized to the HVAC unit capacity. A minimum of one electrode pair per 2,400 cfm of air flow shall be provided. Bipolar ionization tubes manufactured of glass and steel mesh shall not be acceptable due to replacement requirements, maintenance, performance output reduction over time, ozone production and corrosion.
   3. Electrodes shall be energized when the main unit disconnect is turned on and the fan is operating. Electrodes shall be made from carbon fiber to prevent oxidation over time. Internal circuitry shall be provided to sense air flow across the electrode output. Ionization

systems requiring the use of a mechanical air pressure switch to cycle the electrodes only when the fan is operating shall not be acceptable due to high failure rates and pressure sensitivity.

4. Electrode pair shall provide a minimum of 160M ions/cc/sec as measured at 2", both positive and negative ions, in equal quantities. Devices providing less than 160M ions/cc per electrode pair shall not be acceptable.
5. Each system shall have an automatic self-cleaning feature. Systems without a no-maintenance, automatic self-cleaning feature shall not be acceptable.
6. Each electrode pair shall be designed with a banana style plug such that it can be field replaced, if necessary.
7. Each system shall be provided with an inline on/off switch, universal voltage input (24VAC to 240VAC or DC), and replaceable carbon fiber emitters.
8. Units shall be mounted in the supply fan inlet(s) and oriented in the airstream to prevent ionization cancellation. For blow-thru equipment, mount the unit downstream of the evaporator coil. Secure to the equipment with magnets.

F. Dual Electrode Air Treatment Systems Up To 2,400 cfm (Basis of Design is *GPS-FC24-AC*):
1. Where so indicated on the plans and/or schedules, air treatment systems shall be supplied and installed. The mechanical contractor shall mount the systems and wire to the HVAC unit control power (24VAC) or EMCS low voltage power per the manufacturer's instructions or line voltage subject to power available. Each system shall be designed with a molded casing, automatic self-cleaning system, self-cleaning test button, power status LED and dry contacts to prove ion output is operating properly. The dry contacts shall close to prove the ion generator is working properly and may be daisy chained in series such that only one dry contact per HVAC unit is required to interface to the EMCS or the optional DDC controller. Dry contacts proving power has been applied in lieu of the ion output operating are not acceptable. Manufacturers providing multiple ion modules that have alarm status wired in parallel, and not in series, shall not be acceptable.
2. Each system shall include the required number of electrodes and power generators sized to the HVAC unit capacity. A minimum of one electrode pair per 2,400 cfm of air flow shall be provided. Bipolar ionization tubes manufactured of glass and steel mesh shall not be acceptable due to replacement requirements, maintenance, performance output reduction over time, ozone production and corrosion.
3. Electrodes shall be energized when the main unit disconnect is turned on and the fan is operating. Electrodes shall be made from carbon fiber to prevent oxidation over time. Internal circuitry shall be provided to sense air flow across the electrode output. Ionization systems requiring the use of a mechanical air pressure switch to cycle the electrodes only when the fan is operating shall not be acceptable due to high failure rates and pressure sensitivity.
4. Electrode pair shall provide a minimum of 300M ions/cc/sec as measured at 2", both positive and negative ions, in equal quantities. Devices providing less than 300M ions/cc per electrode pair shall not be acceptable.
5. Each system shall have an automatic self-cleaning feature. Systems without a no-maintenance, automatic self-cleaning feature shall not be acceptable.
6. Each electrode pair shall be designed with a banana style plug such that it can be field replaced, if necessary.
7. Each system shall be provided with an inline on/off switch, universal voltage input (24VAC to 240VAC or DC), and replaceable carbon fiber emitters.
8. Units shall be mounted in the supply fan inlet(s) and oriented in the airstream to prevent

ionization cancellation. For blow-thru equipment, mount the unit downstream of the evaporator coil. Secure to the equipment with magnets.

G. Dual Electrode Air Treatment Systems Up To 4,800 cfm (Basis of Design is *GPS-FC48-AC*):
   1. Where so indicated on the plans and/or schedules, air treatment systems shall be supplied and installed. The mechanical contractor shall mount the systems and wire to the HVAC unit control power (24VAC) or EMCS low voltage power per the manufacturer's instructions or line voltage subject to power available. Each system shall be designed with a molded casing, automatic self-cleaning system, self-cleaning test button, power status LED and dry contacts to prove ion output is operating properly. The dry contacts shall close to prove the ion generator is working properly and may be daisy chained in series such that only one dry contact per HVAC unit is required to interface to the EMCS or the optional DDC controller. Dry contacts proving power has been applied in lieu of the ion output operating are not acceptable. Manufacturers providing multiple ion modules that have alarm status wired in parallel, and not in series, shall not be acceptable.
   2. Each system shall include the required number of electrodes and power generators sized to the HVAC unit capacity. A minimum of one electrode pair per 4,800 cfm of air flow shall be provided. Bipolar ionization tubes manufactured of glass and steel mesh shall not be acceptable due to replacement requirements, maintenance, performance output reduction over time, ozone production and corrosion.
   3. Electrodes shall be energized when the main unit disconnect is turned on and the fan is operating. Electrodes shall be made from carbon fiber to prevent oxidation over time. Internal circuitry shall be provided to sense air flow across the electrode output. Ionization systems requiring the use of a mechanical air pressure switch to cycle the electrodes only when the fan is operating shall not be acceptable due to high failure rates and pressure sensitivity.
   4. Electrode pair shall provide a minimum of 400M ions/cc/sec as measured at 2", both positive and negative ions, in equal quantities. Devices providing less than 400M ions/cc per electrode pair shall not be acceptable.
   5. Each system shall have an automatic self-cleaning feature. Systems without a no-maintenance, automatic self-cleaning feature shall not be acceptable.
   6. Each electrode pair shall be designed with a banana style plug such that it can be field replaced, if necessary.
   7. Each system shall be provided with an inline on/off switch, universal voltage input (24VAC to 240VAC or DC), and replaceable carbon fiber emitters.
   8. Units shall be mounted in the supply fan inlet(s) and oriented in the airstream to prevent ionization cancellation. For blow-thru equipment, mount the unit downstream of the evaporator coil. Secure to the equipment with magnets.

H. Electrical Requirements: Wiring, conduit and junction boxes shall be installed within housing plenums in accordance with *NEC NFPA 70*. The contractor shall coordinate electrical requirements with system manufacturer during submittals. Where necessary, provide matching dedicated power supply transformer.

I. Control Requirements:
   1. Air Treatment Systems shall have internal short circuit protection, overload protection, and automatic fault reset circuit breakers. Systems with manual fuses shall not be allowed.
   2. Integral airflow sensing shall modulate the plasma output as the airflow varies or stops. A mechanical airflow switch shall not be acceptable to activate the Plasma device due to high

failure rates and possible pressure reversal.

3. The installing contractor shall mount and wire the systems within the HVAC units specified or as shown or the plans. The contractor shall follow all manufacturer IOM instructions during installation.
4. All systems shall have a means to interface with an EMCS system. Dry contacts shall be provided to prove ions being produced. Systems providing indication that power is applied to the system, but not directly sensing the power at the ion output, shall not be acceptable.

PART 3 - EXECUTION

3.1 GENERAL:

A. The Contractor shall be responsible for maintaining all Air Treatment Systems until the Owner accepts the building.

B. Dual electrode systems (*CI-2*) shall be used for all thru-wall heat pumps (THP), ductless wall and cassette air handlers (DAH), VRF wall and cassette air handlers (VAH), wall air conditioners (WAC), wall heat pumps (WHP), split system air handlers (AH), and gas furnaces (GF). Use multiple systems as needed based on cfm.

C. Dual electrode systems (*FC24, FC48*) shall be used for all roof air conditioners (RAC), roof heat pumps (RHP), dedicated outdoor air systems (DOAS), and energy recovery ventilators (ERV). Use multiple systems as needed based on cfm.

3.2 INSTALLATION:

A. All equipment shall be assembled and installed in a workman like manner.

B. Any material damaged by handling, water or moisture shall be replaced by the Contractor at no cost to the Owner.

C. All equipment shall be protected from dust and damage daily throughout construction.

3.3 TESTING:

A. Provide the manufacturers recommended electrical tests.

3.4 STARTUP AND TRAINING:

A. A manufacturer's authorized representative shall provide start-up supervision and training of owner's personnel in the proper operation and maintenance of all equipment.

END OF SECTION 23 43 20

SECTION 23 53 10 - AIR CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:

A. Manufacturers:

1. *Carrier* is the Basis of Design manufacturer for Roof Air Conditioners. Equivalent name brand equipment manufactured by *Trane, Daikin. York* and *Johnson* that meets performance, capacity, space and other requirements of the design documents shall be acceptable.

2. The owner’s equipment preference is *Daikin*. Contractor shall provide a separate line item in their bid to provide Owner preferred equipment.

B. Industry Standards:

1. Comply with applicable provisions of NFPA Standards 90A pertaining to construction and installation of air conditioning units.
2. Provide units which shall comply with applicable portions of UL 465, and with electrical components that bear UL labels.
3. Units shall be rated and certified in accordance with ARI Standard 210 and 270 as applicable.
4. Comply with installation requirements of ANSI/ASHRAE 15; *Safety Code for Mechanical Refrigeration*.
5. Extended Warranty: In addition to the standard one-year warranty on all components, compressors shall bear an additional four-year manufacturer's warranty against material and design defects.

1.3 SUBMITTALS:

A. Provide manufacturer's data, test reports, and product warranties for all items as applicable.

PART 2 - PRODUCTS

2.1 ROOF AIR CONDITIONERS:

A. General: Units shall be one-piece construction, UL certified, complete with refrigerant and ready to operate as year-round air conditioning systems. Units shall be complete with compressors, coils, electric heat, fans, casings, filters and controls. Provide adaptive dehumidification system capable of operating in normal cooling, subcooling and hot gas reheat modes.

B. Compressor(s) shall be the scroll type and shall be provided with crankcase heaters and constant pressure lubrication. Compressor(s) shall be isolated from the frame by resilient mounts. Provide low ambient controls. Factory charge with HFC refrigerant. Systems scheduled on the plans for Staged Air Volume shall be equipped with minimum 2-stage control.

C. Indoor and outdoor coils shall be constructed of copper tubes with aluminum fins mechanically bonded to the tubes. The coils shall be factory pressure and leak tested at not less than 425 psig.

D. Fans shall be balanced statically and dynamically, and fan bearings shall be permanently lubricated types. Fan motors shall have built-in overload protection. Outdoor fans shall be the direct-drive propeller type. Indoor fans shall be the centrifugal belt-driven type mounted on vibration isolators. Systems scheduled on the plans for Staged Air Volume shall be equipped with variable frequency drives and inverter duty fan motors.

E. Outdoor unit casings shall be constructed of galvanized sheet steel and of modular construction, rigidly braced and reinforced with steel angle framework and of sufficient strength to prevent bending during rigging. Treat surface and finish corrosive-resistant steel panels with manufacturer's standard baked seal against weather and air leakage with gaskets. Thermally insulate the interior casing in contact with the airstream with 1 inch glass fiber. Design top panels for proper drainage. Fasten top panels to be easily individually removable for complete access to components from the top of the unit and seal the top against air and water leakage with gasketing. Provide drains on both sides of the condenser section and provide a utility connection opening within unit curb connections. Connectors occurring in wet areas such as the outdoor fan section shall be factory or field weatherproofed. Provide units with condenser coil guards and hinged access doors. Provide matching roof curbs suitable for the roof slope. Curbs shall extend minimum 8 inches above roof surface. Units shall be capable of resisting wind load specified in 239110.

F. Air filters shall be located inside the air conditioning unit casing and shall be pleated minimum MERV 13. Filters shall conform to SCCPSS approved sizes. Contact SCCPSS Facility Department for approved list.

G. Units shall come equipped with motorized outdoor air dampers. Units with SAV shall come equipped with outside air flow measuring stations and outdoor air damper controls to provide the constant scheduled outdoor air CFM under all supply air conditions.

H. Where scheduled, units shall come equipped with dry bulb economizer operation and barometric relief.

I. Provide units with controls equipped with time-delay devices with the capability to prevent short cycling of compressor(s) and to ensure staged starting of dual compressor units. Provide units with 24 volt internal control wiring with plug-in type relays for reliability and ease of maintenance. Each unit shall have high pressure stats, low pressure stats, loss of

charge protection, indoor coil freeze stats and current and temperature-sensitive overload devices. Provide power phase monitoring accessory to protect equipment from phase loss and / or phase reversal for units with 3 phase power requirements.

J. Electric resistance heaters shall be the open wire type with a galvanized steel frame. Heaters shall be heavy duty nichrome wire complete with safety and operating controls to meet UL and NEC requirements.

K. Where scheduled, provide energy recovery wheel assembly. Wheel shall be the enthalpy type for both sensible and latent heat recovery and be designed to ensure laminar flow. Energy transfer ratings must be ARI Certified to Standard 1060 and bear the ARI certification symbol for ARI Air-to-Air Energy Recovery Ventilation Equipment Certification Program based on ARI 1060. Desiccant shall be silica gel permanently bonded to wheel media. Wheel shall be constructed of lightweight polymer material mounted in a stainless steel rotor. Wheels greater than 26 inch diameter shall have removable segments. Wheel drive belt shall be high strength urethane factory installed in a pre-stretched state. Wheel shall be equipped with factory installed pressure test ports to allow measurement of the wheel's pressure drop. Provide units with motor status switch, wheel rotation sensors, factory installed filter differential pressure switch, motorized supply and exhaust dampers, roof curb extension, and a slide-out track for wheel maintenance. Listed manufacturers that do not have an integral energy recovery option available shall provide a engineered package system on a combo curb as specified in section 237220.

L. HVAC drain piping shall be schedule 40 PVC pipe with socket type fittings and solvent cement joints. Piping exposed above the roof shall receive two coats of white latex paint for UV protection. Provide non-penetrating neoprene roof pedestal pipe supports with clamps on maximum five foot spacing.

M. All controls shall be full DDC under section 23 8310.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Installer must examine areas and conditions under which air conditioning units are to be installed and notify the Owner in writing of conditions detrimental to the proper completion of the work. Do not proceed with the work until the unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF AIR CONDITIONERS:

A. Install units where shown, in accordance with equipment manufacturer's written instructions and recognized industry practices, to insure that units comply with requirements and serve intended purposes.

B. Coordinate with other work, including structural, ductwork, piping and electrical work, as necessary to interface installation of units with other work. Control wiring and devices for

complete, operable systems shall be provided and installed under the Mechanical specifications. Wiring shall be installed in conduit provided and installed under the Electrical specifications.

3.3 TESTING:

A. Upon completion of installation of air conditioning units and connection to the completed air distribution system, start-up and test equipment in accordance with manufacturer's recommendations. Operate units to demonstrate capability and compliance with requirements. Where possible, field-correct malfunctioning units, then retest to demonstrate compliance.

END OF SECTION 23 53 10

SECTION 23 61 10 – HEAT PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:

A. Manufacturers:

1. *Carrier* is the Basis of Design manufacturer for Ductless Heat Pumps. Equivalent name brand equipment manufactured by *Mitsubishi, Daikin,* and *Trane* that meets performance, capacity, space and other requirements of the design documents shall be acceptable.

2. The owner's equipment preference is *Daikin*. Contractor shall provide separate line item in their bid to provide Owner preferred equipment.

B. Industry Standards:

1. Comply with applicable provisions of NFPA Standard 90A pertaining to construction and installation of air conditioning units.
2. Provide units which shall comply with applicable portions of UL 465, and with electrical components that bear UL labels.
3. Units shall be rated and certified in accordance with ARI Standard 240, 270 or 380 as applicable.
4. Comply with installation requirements of ANSI/ASHRAE 15; *Safety Code for Mechanical Refrigeration*.

C. Extended Warranty: In addition to the standard one-year warranty on all components, compressors shall bear an additional four-year manufacturer's warranty against material and design defects.

1.3 SUBMITTALS:

A. Provide manufacturer's data, test reports, and product warranties for all items as applicable.

PART 2 - PRODUCTS

2.1 DUCTLESS HEAT PUMPS:

A. General: Indoor and outdoor units shall be a matched pair of one manufacturer rated for operation together by the manufacturer's published literature. The system shall be furnished complete with packaged indoor unit, packaged outdoor unit, refrigerant lines and all necessary controls and accessories for a complete, operational system.

B. Outdoor units shall consist of hermetic scroll compressors(s) with crankcase heaters, automatically reversible oil pump, internal and external motor protection, outdoor fan(s) of the propeller type with direct drive factory lubricated motor(s) and outdoor coil all housed in a heavy duty steel casing with baked enamel factory-applied finish. Provide units with single point power connection and condenser coil guards.

C. Indoor units (air handlers) shall be the horizontal wall mounted, vertical type, or ceiling cassette type complete with statically and dynamically balanced centrifugal direct drive fan, indoor coil, electric heater, standard filters, expansion valves and relays, and controls all housed in a factory-fabricated and insulated steel housing with baked enamel finish. Provide single point power connection. Provide a spare washable filter for each unit.

D. Unit controls and protective devices shall include high pressure stat, loss of charge pressure stat, suction line accumulator and pressure relief device. Motor compressors shall have a thermal and current sensitive overload device. The outdoor unit shall have short cycle protection and safety lock-out compressor protection. Automatic defrost controls shall be provided. Factory charge with HFC refrigerant. Provide condensate overflow switch.

E. Refrigerant piping shall be hard drawn seamless copper tubing suitable for a working pressure of 600 psig. Fittings shall be wrought copper or brass suitable for use with high temperature solder and designed for 600 psig working pressure. Suction line insulation shall be plenum rated closed cell foam plastic insulation.

F. For units discharging directly to drain boxes, HVAC drain piping shall be Schedule 40 PVC pipe with socket type fittings and solvent cement joints. All other installation shall be Type ‘L’ copper and wrought fittings.

G. Provide 24V interface to connect and control thru the EMCS.

H. See section 23 83 10 for more information.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Installer must examine areas and conditions under which heat pumps are to be installed and notify the Contractor in writing of conditions detrimental to the proper completion of the work. Do not proceed with the work until the unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF HEAT PUMPS:

A. Install heat pumps where shown, in accordance with equipment manufacturer's written instructions and recognized industry practices, to insure that units comply with requirements and serve intended purposes.

B. Coordinate with other work, including structural, ductwork, piping and electrical work, as necessary to interface installation of heat pumps with other work. Control wiring and devices for complete, operable systems shall be provided and installed under the Mechanical specifications. Wiring shall be installed in conduit provided and installed under the Electrical specifications.

C. Piping: Refrigerant line joints shall be brazed with silver solder. Lines shall be sized, installed and insulated in accordance with equipment manufacturer's instructions. Suction line insulation joints shall be sealed with an adhesive recommended by the insulation manufacturer. All refrigerant line insulation exposed to weather shall be protected with a weatherproof coating supplied by the insulation manufacturer. Suction and hot gas line sets shall be secured together with plastic ties. Tape or coated wire shall not be allowed. Hot gas lines located within walls shall also be insulated for vibration isolation. Bare copper piping shall not be allowed to come in contact with masonry, mortar, or steel items. Condensate lines shall be installed with traps and vents in each line. Pipe supports shall be on maximum 6 foot centers on horizontal lines. Open ends of lines and connection fittings of equipment shall be properly capped or plugged during construction to protect from damage and entry of dirt or foreign material.

D. The mounting height of each wall mounted thermostat or temperature sensor shall comply with ADA for maximum side reach. The thermostat or sensor shall be at 48” maximum above the floor.

3.3 TESTING:

A. Upon completion of installation of heat pumps and connection to the completed air distribution system, start-up and test equipment in accordance with the manufacturer's recommendations. Operate units to demonstrate capability and compliance with requirements. Where possible, field-correct malfunctioning units, then retest to demonstrate compliance.

END OF SECTION 23 61 10

SECTION 23 63 10 – VRF HEAT PUMPS

PART 1 – GENERAL

1.1 SYSTEM DESCRIPTION:

A. The HVAC Basis of Design is VRF Heat Recovery Heat Pumps by *Carrier*. Mechanical plans, electrical plans and specifications have been prepared on this basis. Alternate name brand manufacturers allowed to bid are *Mitsubishi* and *Trane*. Alternate manufacturers must meet the scheduled equipment performance and specification requirements. Variations in equipment dimensions, refrigerant piping design, solenoid valve locations, controls, power requirements, etc. must be furnished and installed at no additional cost to the Owner. All such variations must be clearly noted in the VRF submittal including a document confirming prior coordination with the general contractor and electrical contractor.

B. The heat recovery VRF systems shall consist of an outdoor unit, heat recovery controller(s), multiple indoor units, zone controllers, and a Direct Digital Controls (DDC) Central Controller. Each indoor unit or group of indoor units shall be capable of operating in any mode independently of other indoor units or groups. System shall be capable of changing mode (cooling to heating, heating to cooling) with no interruption to system operation. Each indoor unit or group of indoor units shall be independently controlled.

C. The owner's equipment preference is *Daikin*. Contractor shall provide a separate line item in their bid to provide Owner preferred equipment.

1.2 QUALITY ASSURANCE:

A. Industry Standards:

1. The units shall be listed by Electrical Laboratories (ETL) and bear the ETL label.
2. All wiring shall be in accordance with the National Electrical Code (N.E.C.).
3. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).

1.3 DELIVERY, STORAGE AND HANDLING:

A. Unit shall be stored and handled according to the manufacturer's recommendation.

1.4 WARRANTY:

A. The units shall be covered by the manufacturer's limited warranty for a period of five (5) years from date of installation. In addition, the compressor shall have a manufacturer's limited warranty for a period of seven (7) years from date of installation. If, during this

period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. This warranty shall not include labor.

B. The system shall be installed by a factory authorized contractor with factory installation and service training. The mandatory contractor service and installation training should be performed by the manufacturer.

PART 2 – PRODUCTS

2.1 OUTDOOR UNITS:

A. General: The outdoor unit shall be used specifically with matching components. The outdoor units shall be equipped with multiple circuit boards that interface to the VRF controls system and shall perform all functions necessary for operation. Each outdoor unit module shall be completely factory assembled, piped and wired and run tested at the factory.

1. All units requiring a factory supplied twinning kits shall be piped together in the field, without the need for equalizing line(s).
2. All refrigerant lines from the outdoor unit shall be insulated.
3. The outdoor unit shall have an accumulator with refrigerant level sensors and controls.
4. The outdoor unit shall have a high pressure safety switch, over-current protection, crankcase heater and DC bus protection.
5. The outdoor unit shall have the ability to operate with the refrigerant piping lengths required by the locations of equipment shown on plans.
6. The outdoor unit shall be capable of operating in heating mode down to -4°F ambient temperature or cooling mode down to 23°F ambient temperature, without additional low ambient controls.
7. The outdoor unit shall not cease operation in any mode based solely on outdoor ambient temperature.
8. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.

B. Unit Cabinet:
1. The casing(s) shall be fabricated of pre-coated steel, finished on both inside and outside. Unit cabinets shall be able to withstand 500-hour salt spray test per Federal Test Standard No. 141 (method 6061).

C. Fan:
1. Outdoor units shall be furnished with direct drive, variable speed propeller type fans. The fans shall be factory set for operation under 0 in. WG external static pressure, but capable of normal operation under a maximum of 0.24 in. WG external static pressure via dipswitch.
2. All fan motors shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
3. All fan motors shall be mounted for quiet operation.
4. All fans shall be provided with a raised guard to prevent contact with moving parts.
5. The outdoor unit shall have vertical discharge airflow.

D. Refrigerant
   1. R410A refrigerant shall be required for VRF systems.

E. Coil:
   1. The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
   2. The coil fins shall have a factory applied corrosion resistant blue-fin finish.
   3. The coil shall be protected with an integral metal guard.
   4. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.

F. Compressors:
   1. Each outdoor unit module shall be equipped with one or more inverter driven compressors. Non inverter-driven compressors shall not be allowed.
   2. A crankcase heater(s) shall be factory mounted on the compressor(s).
   3. The compressor will be equipped with an internal thermal overload.
   4. The compressor shall be mounted to avoid the transmission of vibration.

G. Electrical:
   1. The outdoor unit shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz), 207-253V (230V/60Hz) or 414-506V (460V/60Hz).
   2. The outdoor unit shall be controlled by integral microprocessors.
   3. The control circuit between the indoor units and the outdoor units shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.
   4. All multi-module units shall have single-point power connection.

H. Refrigerant Valves:
   1. Service shut-off valves shall be field-provided/installed for each unit's refrigerant pipe connections to isolate each piece of equipment in the VRF system.

I. Piping:
   1. Refrigerant piping shall be copper as recommended by manufacturer with hanger supports as required in specification section 230320. Insulation shall be per VRF manufacturer's recommendations and shall be plenum rated.
   2. HVAC drain piping shall be Schedule 40 PVC pipe with socket type fittings and solvent cement joints. Insulate with 1 inch thick plenum rated fiberglass with vapor barrier.

2.2 HEAT RECOVERY CONTROLLERS FOR HEAT RECOVERY SYSTEMS:

A. General: The Heat Recovery Controllers (HRC) shall be specifically used with R410A systems. These units shall be equipped with a circuit board that interfaces to the controls system and shall perform all functions necessary for heat recovery operation. The heat recovery controller shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory. This unit shall be mounted indoors, with access and service clearance provided for each controller. Provide a spare port for all HRCs with 8 ports or less. For HRCs with more than 8 ports, provide two spare ports. Service shut-off valves shall be

field-provided/installed for all refrigerant pipe connections at the HRC to isolate each piece of equipment in the VRF system.

2.3 WALL MOUNT INDOOR UNIT:

A. General: The wall mount indoor unit shall have a modulating expansion device. The unit shall support individual control using DDC controllers.

B. Indoor Unit: The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

C. Unit Cabinet: The casing shall have a white finish. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining shall be standard. There shall be a separate back plate which secures the unit firmly to the wall.

D. Fan: The indoor fan shall be an assembly with one or two line-flow fan(s) direct driven by a single motor. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings. A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right). A motorized air sweep louver shall provide an automatic change in airflow by directing the air up and down to provide uniform air distribution.

E. Filter: Return air shall be filtered by means of an easily removable, washable filter. Provide a spare washable filter for each unit.

F. Coil: The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy. The coils shall be pressure tested at the factory. A condensate pan and drain shall be provided under the coil. Both refrigerant lines to the indoor unit shall be insulated.

G. Electrical: The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz)

A. Provide manufacturer’s 24V thermostat interface for EMCS control and monitoring. See section 238310 for more information.

2.4 4-WAY CEILING-RECESSED CASSETTE INDOOR UNIT:

A. General: The unit shall be a four-way cassette style indoor unit that recesses into the ceiling with a ceiling grille. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation

function, a test run switch, and the ability to adjust airflow patterns for different ceiling heights. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

B. Unit Cabinet: The cabinet shall be space-saving ceiling-recessed cassette. Branch ducting shall be allowed from cabinet. Four-way grille shall be fixed to bottom of cabinet allowing two, three or four-way blow. The grille vane angles shall be individually adjustable from the wired remote controller to customize the airflow pattern for the conditioned space

C. Fan: The indoor fan shall be an assembly with a turbo fan direct driven by a single motor. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings. The indoor fan shall consist of four (4) speed settings, Low, Med, High and Auto. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature. The indoor unit shall have an adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow. The indoor unit shall have switches that can be set to provide optimum airflow based on ceiling height and number of outlets used. The auto air swing vanes shall be capable of automatically swinging up and down for uniform air distribution.

D. Filter: Return air shall be filtered by means of a long-life washable filter. Provide a spare washable filter for each unit.

E. Coil: The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy. The coils shall be pressure tested at the factory. A condensate pan and drain shall be provided under the coil. The unit shall be provided with an integral condensate lift mechanism that will be able to raise drain water 33 inches above the condensate pan. Both refrigerant lines to the PLFY indoor units shall be insulated.

F. Electrical: The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

G. Controls: Provide manufacturer’s 24V thermostat interface for EMCS control and monitoring. See section 238310 for more information.

H. Drain Adapter: Adapter shall consist of insulated transition and hose clamps on both ends.

2.5 1-WAY CEILING-RECESSED CASSETTE INDOOR UNIT:

A. General: The unit shall be a one-way cassette style indoor unit that recesses into the ceiling with a ceiling grille. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

B. Unit Cabinet: The cabinet shall be a ceiling-recessed cassette. One-way grille shall be fixed to bottom of cabinet.

C. Fan: The indoor fan shall be an assembly with a turbo fan direct driven by a single motor. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings. The indoor fan shall consist of three (3) speeds, Low, Mid, and High. The auto air swing vanes shall be capable of automatically swinging up and down for uniform air distribution.

D. Filter: Return air shall be filtered by means of a long-life washable filter. Provide a spare washable filter for each unit.

E. Coil: The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy. The coils shall be pressure tested at the factory. A condensate pan and drain shall be provided under the coil. The unit shall be provided with an integral condensate lift mechanism that will be able to raise drain water 19-3/4" inches above the condensate pan. Both refrigerant lines to the indoor units shall be insulated. Provide condensate overflow switch.

F. Electrical: The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

G. Controls: Provide manufacturer's 24V thermostat interface for EMCS control and monitoring. See section 238310 for more information.

2.6 VERTICAL AIR HANDLER INDOOR UNIT:

A. General: The unit shall be a vertical ducted indoor fan coil design capable of horizontal installation with end supply and return air duct connections. Units shall have a modulating expansion device. The unit shall support individual control using DDC controllers.

B. Indoor Unit: The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

C. Unit Cabinet: The unit shall be pre-painted steel with R-4.2 insulation.

D. Fan: The indoor unit fan shall be an assembly with a forward curved fan direct driven by a high efficiency DC motor. The indoor fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings. The indoor unit shall have a ducted air outlet system and ducted return air system.

E. Filter: Provide a filter rack with MERV 7 filters, unless noted otherwise. Shall be 2" pleated minimum MERV 8. Access to filters shall be unrestricted. Provide factory fabricated 4-sided filter rack with hinged door and 1" return air duct collars (NO EXCEPTIONS). Filters

shall conform to SCCPSS approved sizes. Contact SCCPSS Facility Department for approved list. Provide 3 sets of filters with each unit.

F. Coil: The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy. The coils shall be pressure tested at the factory. A condensate pan and drain shall be provided under the coil. The condensate shall be gravity drained from the fan coil. Both refrigerant lines to the indoor unit shall be insulated. Provide condensate overflow switch.

G. Electrical: The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

H. Controls: This unit shall use controls provided by the manufacturer to perform functions necessary to operate the system.

PART 3 – CONTROLS

3.1 OVERVIEW:

A. General: The Controls Network (CN) shall be capable of supporting remote controllers, schedule timers, system controllers, centralized controllers, an integrated web based interface, graphical user workstation, and system integration to EMCS via BACnet.

3.2 ELECTRICAL CHARACTERISTICS:

A. General: The CN shall operate at 24VDC. Controller power and communications shall be via a common non-polar communications bus.

B. Wiring: Control wiring shall be installed in a system daisy chain configuration from indoor unit to ME remote controller to indoor unit, to the BC controller (main and subs, if applicable) and to the outdoor unit. Control wiring to remote controllers shall be run from the indoor unit terminal block to the controller associated with that unit. Control wiring for schedule timers, system controllers, and centralized controllers shall be installed in a daisy chain configuration from outdoor unit to outdoor unit, to system controllers, to the power supply. Control wiring for the remote controllers shall be from the remote controller to the first associated indoor unit, then to the remaining associated indoor units in a daisy chain configuration. The system controller shall be capable of being networked with other system controllers for web based control.

C. Wiring type: Wiring shall be 2-conductor (16 AWG), twisted shielded pair, stranded wire, as defined by the Design Tool AutoCAD output. Network wiring shall be CAT-5e with RJ-45 connection.

3.3 CONTROLS NETWORK:

A. The Controls Network (CN) consists of remote controllers, schedule timers, system controllers, centralized controllers, and/or integrated web based interface communicating over a high-speed communication bus. The Controls Network shall support operation monitoring, scheduling, error email distribution, personal browsers, tenant billing, online maintenance support, and integration with EMCS using BACnet interface.

3.4 CN REMOTE CONTROLLERS:

A. The Remote Controller shall be compact in size, approximately 3" x 5" and have limited user functionality. The unit supports temperature display selection of Fahrenheit or Celsius. The Remote Controller shall allow the user to change on/off, mode (cool, heat, auto, dry, and fan), temperature setting, and fan speed setting. The Remote Controller shall be able to limit the set temperature range from the controller. The room temperature shall be sensed at either the Remote Controller or the Indoor Unit dependent on the indoor unit dipswitch setting. The Remote Controller shall display a four-digit error code in the event of system abnormality/error. The Remote Controller shall require no addressing. The Remote Controller shall connect using two-wire, stranded, non-polar control wire to connection terminal on the indoor unit.

3.5 INPUT/OUTPUT (IO) BOARDS:

A. Digital Input Digital Output (DIDO) Board: The DIDO IO board shall be capable of providing On/Off control for other equipment via the Centralized Controller's licensed web browser functions. Each DIDO board shall have two digital inputs and two digital outputs and shall be capable of expanding to a total of six digital inputs and six digital outputs. Each digital output shall be capable of supporting an independent schedule via the Centralized Controller's licensed web browser functions. Status indication of the On/Off state of the other equipment shall be either via the On/Off status of the digital output or by receipt of a digital input to the DIDO board. The DIDO IO board shall be capable of receiving a digital input for interlock settings with the indoor units or digital outputs on the DIDO board. Based on the digital input status the DIDO board shall be capable of setting the following parameter on the indoor unit On/Off, Mode, and Set Temperature to predefined settings. The DIDO board shall also be capable of interlocking the On/Off state of a digital output on the DIDO board based on a digital input status.

B. Analog Input (AI) Board: The AI IO board shall be capable of monitoring temperature or humidity via the Centralized Controller's licensed web browser functions. Each AI board shall have two analog inputs. Each input shall be capable of receiving a 4/20mA, 0/10 VDC, or 1/5 VDC signal for monitoring temperature or humidity. The AI board shall be capable of monitoring the temperature or humidity input and shall be capable of displaying graphical trending of the temperature or humidity values via the Centralized Controller's licensed web browser functions. Notification of user adjustable high and low level alarms shall be capable of being emailed to distribution list or outputted via a digital output. The AI IO board shall be capable of setting the following parameters on the indoor unit On/Off, Mode, and Set Temperature to predefined settings based on the input value of the temperature or humidity. The AI board shall also be capable of interlocking the On/Off state of a digital output on the input value of the temperature or humidity.

3.6 CENTRALIZED CONTROLLER:

A. The Centralized Controller shall be capable of controlling a maximum of 50 indoor units across multiple outdoor units. The Centralized Controller shall be approximately 5”x11” in size and shall be powered from a Power Supply Unit. The Centralized Controller shall support operation superceding that of the remote controllers, system configuration, daily/weekly/annual scheduling, monitoring of operation status, error email notification, online maintenance tool and malfunction monitoring. The Centralized Controller shall have basic operation controls which can be applied to an individual indoor unit, a group of indoor units (up to 50 indoor units), or all indoor units (collective batch operation). This basic control set of operation controls for the Centralized Controller shall include on/off, operation mode selection (cool, heat, auto (R2-Series only), dry, and fan), temperature setting, fan speed setting, airflow direction setting, error email notification, and online maintenance. Since the provides centralized control it shall be able to enable or disable operation of local remote controllers via the PC. In terms of scheduling, the Centralized Controller shall allow the user to define daily, weekly, and annual schedules with operations consisting of ON/OFF, mode selection, temperature setting, and permit/prohibit of remote controllers.

B. Standard software functions shall allow the building manager to securely log into each unit via the PC’s web browser to support operation monitoring, scheduling, error email, and online maintenance diagnostics. Standard software functions shall not expire. Additional optional software functions shall be available for personal browser for PCs and MACs. BACnet interface shall be available through software operating on a dedicated PC and a license. Optional software functions shall require advance purchasing and can only be activated upon receipt of a license number from the manufacturer.

3.7 WEB-BASED USER INTERFACE: Licenses per function, per centralized controller shall be required. All PCs shall be field supplied.

A. PC-Monitoring (SW-Mon): The CN shall be capable of monitoring and operating all indoor units from a networked PC’s web browser for up to 50 units per centralized controller.

B. PC Scheduling (SW-Sch): The CN shall be capable of creating customized daily, weekly, and annual schedules from a network PC’s web browser for up to 50 units per centralized controller. Schedules shall be applied to a single indoor unit, a group of indoor units, or collectively (batch) to all indoor units.

C. Online Error Email (SW-Email): The CN shall be capable of sending detailed alerts to customizable distribution lists based on user defined error types.

D. Personal Web Browser (SW-Pweb): The CN shall be capable of allowing up to 50 individual users to monitor and control user defined zones via a network PC or MAC’s web browser.

E. Online Maintenance Diagnostics (SW-Maint): The CN shall be capable of performing maintenance diagnostics via a network PC and centralized controller using Maintenance Tool Software.

3.8 SYSTEM INTEGRATION: The CN shall be integrated with EMCS via BACnet® interface.

A. The BACnet® interface shall be compliant with BACnet/IP (ANSI/ASHRAE 135-1995, 135a) and UDP/IP of Ethernet (ANSI/ASHRAE 135-1995, 135b). The BACnet interface shall require a dedicated network computer and activated BACnet software function via manufacturer issued license. The BACnet software license shall be on a per centralized controller basis for a maximum of 50 indoor units controlled by one Centralized Controller. The BACnet interface shall support a maximum of ten Centralized Controllers for a maximum of 500 indoor units. Operation and monitoring points include, but are not limited to, on/off, operation mode, fan speed, prohibit remote controller, filter sign reset, alarm state, error code, and error address.

3.9 POWER SUPPLY: The power supply shall supply 12VDC for the centralized controller and 24VDC voltage for the central control transmission.

PART 4 - EXECUTION

4.1 INSPECTION:

A. Installer must examine areas and conditions under which units are to be installed and notify the Contractor in writing of conditions detrimental to the proper completion of the work. Do not proceed with the work until the unsatisfactory conditions have been corrected in a manner acceptable to Installer.

4.2 INSTALLATION:

B. Install units where shown, in accordance with equipment manufacturer's written instructions and recognized industry practices, to insure that units comply with requirements and serve intended purposes.

C. Coordinate with other work, including structural, ductwork, piping and electrical work, as necessary to interface installation of units with other work. Control wiring and devices for complete, operable systems shall be provided and installed under Division 23. Wiring shall be installed in conduit provided and installed under Division 26.

D. Piping: Refrigerant line joints shall be brazed with silver solder or made using flame-free refrigerant rated mechanical press fittings by Zoomlock or Viega. Lines shall be sized, installed and insulated in accordance with equipment manufacturer's instructions. Suction line insulation joints shall be sealed with an adhesive recommended by the insulation manufacturer. All refrigerant line insulation exposed to weather shall be protected with metal jackets. Suction and hot gas line sets shall be secured together with plastic ties. Tape or coated wire shall not be allowed. Hot gas lines located within walls shall also be insulated for vibration isolation. Bare copper piping shall not be allowed to come in contact with masonry, mortar, or steel items. HVAC drain lines shall be installed with traps and vents in each line. Pipe supports shall be on maximum 6 foot centers on horizontal lines. Open ends of lines and connection fittings of equipment shall be properly capped or plugged during

construction to protect from damage and entry of dirt or foreign material.

PART 5 – COMMISSIONING

5.1 GENERAL:

A. The VRF Manufacturer shall oversee and assist the installing contractor with the startup and commissioning of VRF equipment as outlined below. This process will be completed in two phases. Phase one shall cover the Pre-Start-Up inspection process, Phase two will cover the Physical Start-Up and Commissioning of Equipment.

B. All VRF System Commissioning activities shall be completed by an employee of the VRF manufacturer whose primary job responsibilities are to provide start up and commissioning of their products; sales staff or in-house support staffs are not permitted to complete this scope of work.

C. A factory certified representative may assist the VRF manufacturer's personnel in the completion of certain elements of work contained within this specification. Activities completed by a Factory Certified Representative shall be supervised onsite by the VRF manufacturer. Certified representatives shall not be used in lieu of the manufacturer's personnel.

D. The installing contractor shall have been certified by the manufacturer to install VRF systems, having attended a minimum 3- day VRF Service and Installation course at an approved training center. A copy of this certificate shall be presented as part of the VRF equipment submittal process

E. The installing contractor shall assist the VRF manufacturer in their completion of the system review and have available a technician with appropriate diagnostic tools, materials and equipment, as required, for the duration of the inspection process. The technician shall be fully licensed and insured to complete necessary duties as directed under the supervision of the VRF manufacturer.

F. Upon completion of the Equipment Start-Up and VRF Commissioning process, the VRF manufacturer shall provide a formal report outlining the status of the system, in electronic format only. Contained within this report shall be copies of all field inspection reports, required action items and status, Manufacturers design software As-Built, equipment model & serial numbers.

G. Completion of the Equipment Start-Up and VRF Commissioning process shall verify that the VRF system has been installed per the Engineer's design intent and complies with the VRF manufacturer's engineering and installation specifications related to their equipment.

H. Compliance with federal, state and local codes as well as other authorities having jurisdictions are not part of this process and are the responsibility of the installing contractor.

5.2 PRE-START-UP INSPECTION:

A. Contractor shall employ the services of the VRF manufacturer to provide a comprehensive field review of the completed VRF system installation, prior to the physical start up and operation of equipment. Upon satisfaction that the system meets the VRF manufacturer's installation requirements and specifications, the contractor shall be allowed to proceed with the physical start up and operation of equipment.

B. Prior to the pre-start-up inspection, all systems components shall be in a final state of readiness having been fully installed and awaiting inspection.

C. The installing contractor shall provide the VRF manufacturer a copy of the electronic design file used in the design and engineering process of the system being inspected. This electronic design file shall have been completed on software approved by the specified VRF manufacturer and shall have been updated to reflect as-built conditions.

D. The installing contractor shall have prepared the refrigeration piping systems per equipment installation and service manuals. All refrigerant piping systems, upon completion of assembly, shall have been pressurized to a minimum 600 PSI, using dry nitrogen, and held for an uninterrupted 24HR period, with acceptable change due to atmospheric conditions.
   1. A record of the pressure check process shall be recorded and tagged at the heat pump. The tag shall contain the following information: date & time of pressure check start, fill pressure, outdoor temperature at start & stop, date & time of pressure check completion, and the person's full name & company information completing the pressure check.
   2. The installing contractor shall engage the General Contractor as a witness of the pressure check process, confirming that all steps and procedures related to the pressure check where properly followed and that the system held the holding pressure of 600PSI for a period of 24hr hours, with acceptable change due to atmospheric conditions. Witness information, including full name, company name, title, phone number and signature shall be recorded on same pressure tag used by installing contractor.

E. Upon completion of the 600 PSI pressure check, the system shall be evacuated to a level of 500 microns, where it will be held for a period of 1HR with no deflection. The installing contractor shall utilize the triple evacuation method per the equipment install and service manuals.
   1. Evacuation start & stop dates, times, and persons involved shall be recorded and tagged at the outdoor equipment.
   2. Installing contractor shall digitally capture a photo of the micron gauge reading, at the conclusion of the 1hr holding period, for each system and provide a copy to the VRF manufacturer. Each photo shall contain a tag providing the heat pump Serial number.

F. Upon the completion of the 500-micron hold, the calculated additional refrigerant charge can be added. The calculated refrigerant charge shall have been calculated using the VRF manufacturers design software. Total refrigerant charge of the system shall be recorded and displayed at the heat pump by permanent means.

G. A review of the equipment settings shall be completed, with recommendations provided to improve system performance, if applicable. Physical changes of system settings will be completed by the contractor. Electronic recording of final DIP switches shall be provided as part of the commissioning report.

H. A comprehensive review and visual inspection shall be completed for each piece of equipment following a detailed check list, specific to the equipment being reviewed. A copy of the inspection report shall be provided as part of the manufacturers close out documentation. Any deficiencies found during the inspection process shall be brought to the attention of the installing contractor for corrective action. Any system components that are not accessible for proper inspection shall be noted as such.

5.3 PHYSICAL START-UP AND COMMISSIONING OF EQUIPMENT:

A. Upon proper equipment start up by the contractor, following the manufacturers guidelines and specifications, an employee of the VRF manufacturer shall complete a review of the system performance and complete the following tasks:
   1. Check and confirm all communication addressing of system components.
   2. Check and confirm each air handler, individually, is properly piped and wired by commanding the unit on, in both heat and cool mode and verifying proper response. This process shall be digitally recorded and included as part of the close out documentation.
   3. Electronically record a minimum of one-hour of operational data per refrigeration system.
   4. Electronically record selector switch positions on all equipment.

B. The VRF manufacturer shall retain the electronically recorded data, collected during the start-up and equipment commissioning process, at a designated location within the US for future reference.

END OF SECTION 23 63 10

SECTION 23 71 10 – DEDICATED OUTDOOR AIR SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION:

A. The DOAS shall be 100% outdoor air units designed to provide a continuous supply of conditioned, filtered ventilation air.

1.3 QUALITY ASSURANCE:

A. *Greenheck* is the Basis of Design manufacturer for single package DOAS. Equivalent name brand equipment by *Aaon*, *Daikin, Mitsubishi*, and *Reznor* that meets performance, capacity, space, and other requirements of the design documents shall be acceptable.

B. The owner's equipment preference is *Daikin*. Contractor shall provide a separate line item in their bid to provide Owner preferred equipment.

C. Industry Standards:
1. Blowers shall be *AMCA* Certified for airflow.
2. Entire unit shall be *ETL Certified per U.L. 1995* and bear an *ETL* sticker.
3. Comply with installation requirements of *ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration*.
4. Coils shall be Recognized Components for *ANSI/UL 1995, CAN / CSA C22.2 No 236.05*. DX and water coils shall be *AHRI Certified per standard 410-2001*.
5. Indirect gas-fired furnace shall be *ETL* certified as a component of the unit.

D. Warranty:
1. In addition to the standard one-year warranty on all components, compressors shall bear an additional four-year manufacturer's warranty against material and design defects.

1.4 SUBMITTALS:

A. Provide manufacturer's data, test reports, and product warranties as applicable.

PART 2 - PRODUCTS

1.2 SINGLE PACKAGE UNITS:

A. Units shall be single packaged type specifically engineered and designed for 100% outdoor air cooling and heating. The unit shall use DX cooling with modulating hot gas reheat and electric heat, to deliver conditioned, dehumidified, and filtered ventilation air. The units shall be completely factory assembled, piped, fully charged, wired for single point power supply, and tested. All controls shall be factory installed and preset to the design conditions, ready for start-up.

B. Cabinet: The cabinet shall be double wall construction with galvanized steel sheet metal panels and baked enamel finish. Internal assemblies shall be heavy gauge G90 steel. Hinged access doors shall be double wall construction with flush mounted cam latch mechanisms, safety door holders and raised compression gaskets. The roof assembly shall be weatherproof double wall construction. Cabinet insulation shall be 2" thick rigid urethane foam, minimum R-13, meeting *UL94HF-1* flame requirements. Insulation shall provide full coverage of entire exterior to include walls, roof, unit base and doors. The unit shall have a built-in hinged door electrical control panel in a separate compartment from the airstream. The enclosure shall be rated *NEMA* 4. The unit shall have a built-in filter rack with a separate hinged access door. The outdoor air inlet shall have an extruded aluminum storm proof louver with 45-degree blades, 1/2" bird screen, and insulated, low-leakage, motorized outdoor air damper. Provide hail guards and vapor tight interior service lights. Roof units shall have a positive weather-tight seal consisting of a roof curb with a continuous surface for seating on a roof curb gasket. Provide matching roof curbs suitable for the roof slope. Curbs shall extend minimum 8" above roof surface. Units shall be capable of resisting wind load specified in 239110.

C. Supply Fan Section: The supply fan shall be airfoil plenum type, direct drive, mounted on a steel platform with neoprene vibration isolators. Fan shall be statically and dynamically balanced and *AMCA* certified for air and sound performance. Motors shall be heavy-duty permanently lubricated type selected to match the fan load and power supply. Fans shall be capable of continuous speed modulation and controlled by a factory installed VFD.

D. Coils: Evaporator coils, hot gas reheat coils and condenser coils shall be 1/2" seamless copper tubes mechanically expanded with aluminum fins, galvanized steel casing and end plates with plated hardware. Coils shall be factory leak tested at minimum 400 psig air pressure in a water bath. Evaporator coils shall be minimum six rows deep with maximum air velocity of 500 fpm. Where two compressors are used as components of the unit, then the evaporator coil shall be of "interlaced" configuration. Provide a double sloped, self-draining stainless steel drain pan under the entire evaporator coil. All coils shall receive a factory-applied corrosion protection coating.

E. Refrigeration System: The refrigerant compressor(s) shall be digital or inverter-driven hermetic scroll-type and shall be equipped with liquid line filter drier, thermostatic expansion valves (TXV)(s), manual reset high-pressure and low-pressure cutouts and all appurtenant sensors, service ports and safety devices. Compressed refrigerant system shall be fully charged with R-410A refrigerant. Each compressor shall be factory-equipped with an electric crankcase heater to boil off liquid refrigerant from the oil.

F. Condenser Fan Section: Condenser fans shall be of the direct-driven propeller type, mounted for vertical air discharge. The motor shall be inherently protected permanently lubricated with sealed ball bearings and built-in overload protection. Condenser coil guard shall be

heavy gauge welded steel with baked-on epoxy coating.

G. Electric Resistance Heater: Unit shall be equipped with a factory mounted and wired electric heating coil with capacity as scheduled. Heating elements shall be the nickel-chromium resistance wire type supported on ceramic bushings. Power wiring for coil is to be integral to the unit for a single point power connection. Provide airflow switches, contactors, and fusing (as required). Built-in controls shall be supplied with the heater as integral and pre-wired components, contactors, fused control transformer, pressure differential switch, power supply terminals, thermal overheat protection, and solid-state current modulating control (SCR).

H. Filters: Unit shall have permanent 2" aluminum mesh filters located in the outdoor air intake and shall be accessible from the exterior of the unit. Internal 2" thick pleated MERV 13 filters shall be provided in the supply air stream. Filters shall conform to SCCPSS approved sizes. Contact SCCPSS Facility Department for approved list.

I. Electrical: Unit shall have single point power.

J. Controls:
1. The unit shall be constructed so that it can function as a stand-alone heating and cooling system controlled by factory-supplied controllers, thermostats, and sensors, or it can be operated as a heating and cooling system controlled by an Energy Management Control System (EMCS). This unit shall be controlled by a factory-installed microprocessor programmable controller (DDC) that is connected to various optional sensors.
2. Unit shall incorporate a DDC controller with integral LCD screen that provides text readouts of status. DDC controller shall have a built-in keypad to permit operator to access read-out screens without the use of ancillary equipment, devices or software.
3. Supply fan shall be configured for Constant Volume (ON / OFF) as indicated on the plans.
4. Outside Air control shall be field adjustable two-position.
5. Dirty filter sensor shall be factory installed.
6. Provide factory-installed phase monitor to detect electric supply phase loss and voltage brown-out conditions. Upon detection of a fault, the monitor shall disconnect supply voltage to all motors.
7. Variable Frequency Drive (VFD) shall be factory installed for modulation of the supply air fan. The VFD shall be factory-programmed for unit-specific requirements and shall not require additional field programming to operate.
8. Room thermostat shall be provided as a shipped loose item. The room thermostat shall have an LCD display to adjust the room temperature set point from within the space.
9. Provide a built-in airflow measuring station to continuously report airflow cfm to the EMCS.
10. Provide a BACnet interface to the EMCS in section 238310. See section 238310 for additional information.

K. Control Sequences:
1. Occupied Mode: The supply fan shall run continuously and outdoor air damper shall be open during Occupied Mode. The supply fan shall start only after damper status has been proven open.
2. Unoccupied Mode: The DOAS will be off and outdoor air damper will be closed.
3. The unit shall shut down and generate an alarm upon receiving an emergency shutdown signal.

4. The unit shall shut down and generate an alarm upon receiving a smoke detector signal.
5. The unit shall shut down upon activation of building fire alarm system.
6. Outdoor Air Damper Failure Alarm: Commanded open, but the status is closed.
7. Outdoor Air Damper in Hand Alarm: Commanded closed, but the status is open.
8. Internal Alarms shall be provided as follows:
   a. Supply Fan Failure: Commanded on, but the status is off.
   b. Supply Fan in Hand: Commanded off, but the status is on.
   c. Supply Fan Runtime Exceeded: Status runtime exceeds a user definable limit (adj.).
   d. Filter Status: The controller shall monitor the status for outdoor air filters. Filter alarms shall be provided when differential pressure exceeds a user definable limit (adj.).
   e. Supply Air Temperature: The controller shall monitor the supply air temperature. Alarms shall be provided for High Supply Air Temp (If the supply air temperature is greater than 120 F (adj.)) and Low Supply Air Temp (If the supply air temperature is less than 40 F (adj.))
9. Cooling Mode: Cooling shall be enabled during Occupied Mode when the ambient dry bulb temperature exceeds 53 F (adj.). The cooling coil discharge air temperature shall be controlled to maintain the scheduled value. Hot gas reheat shall modulate to maintain the space temperature setpoint of 74 F (adj.).
10. Heating Mode: Heating shall be enabled whenever outdoor air temperature is lower than 52 F (adj.) and the fan status is on. The controller shall measure the supply air temperature and modulate the heater to maintain the space temperature setpoint of 74 F (adj.).

PART 3 - EXECUTION

3.1 INSPECTION:

A. Installer must examine areas and conditions under which units are to be installed and notify the Contractor in writing of conditions detrimental to the proper completion of the work. Do not proceed with the work until the unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION:

A. Install units where shown, in accordance with equipment manufacturer's written instructions and recognized industry practices, to insure that units comply with requirements and serve intended purposes.

B. Coordinate with other work, including structural, ductwork, piping and electrical work as necessary to interface installation of ventilation units with other work. Control wiring, conduit and devices for complete, operable systems shall be provided and installed under the Mechanical specifications.

3.3 TESTING:

A. Upon completion of installation and connection to the completed air distribution system, start-up and test equipment in accordance with the manufacturer's recommendations. Operate units to demonstrate capability and compliance with requirements. Where possible, field-correct malfunctioning units, then retest to demonstrate compliance.

END OF SECTION 23 7110

SECTION 23 72 10 – ENERGY RECOVERY VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION:

A. The ventilators shall be 100% outdoor air units designed to provide a continuous supply of conditioned, filtered ventilation air.

1.3 QUALITY ASSURANCE:

A. *Greenheck* is the Basis of Design manufacturer for Energy Recovery Ventilators. Equivalent name brand equipment by *Aaon*, *Daikin, Mitsubishi*, *Modine, Reznor* and *Valent* that meets performance, capacity, space and other requirements of the design documents shall be acceptable.

B. Industry Standards:

1. Comply with applicable provisions of NFPA 90A pertaining to construction and installation of air conditioning units.
2. Comply with applicable provisions of UL465, and provide UL labels for electrical components.
3. Comply with installation requirements of ANSI/ASHRAE 15; *Safety Code for Mechanical Refrigeration*.
4. Extended Warranty: In addition to the standard one-year warranty on all components, compressors shall bear an additional four-year manufacturer's warranty against material and design defects.

1.4 SUBMITTALS:

A. Provide manufacturer's data, test reports, and product warranties as applicable.

PART 2 - PRODUCTS

2.1 SINGLE PACKAGE UNITS:

A. Units shall be single packaged type air conditioning units specifically engineered and

designed for 100% outdoor air conditioning. The unit shall use DX heat pump cooling/heating with modulating hot gas reheat, auxiliary electric heat and energy recovery to deliver conditioned, dehumidified and filtered ventilation air. Provide a built-in airflow measuring station to continuously report airflow CFM to the EMCS. The units shall be completely factory assembled, piped, fully charged, wired for single point power supply, and tested. All controls shall be factory installed and preset to the design conditions, ready for start-up.

B. Cabinet: The cabinet shall be constructed of 14-gauge satin coated sheet metal with a 12-gauge base. Hinged access doors shall be 2 inch double wall construction with flush mounted cam latch mechanisms, safety door holders and raised compression gaskets. The inner wall shall be minimum 22-gauge galvanized steel. The roof assembly shall also be weatherproof double wall construction. Cabinet finish shall be the manufacturer's standard. Insulation shall be minimum 1 inch thick fiberglass board suitable for 250°F operating temperature and 5000 fpm air velocity. The surface shall be protected with a reinforcing mesh. The unit shall have a built-in hinged door electrical control panel in a separate compartment from the airstream. The enclosure shall be rated NEMA 4. The unit shall have a built-in filter rack with a separate hinged access door. The outdoor air inlet shall have an extruded aluminum storm-proof louver with 45 degree blades and ½ inch bird screen. Roof units shall have a positive weather-tight seal consisting of a roof curb with a continuous surface for seating on a roof curb gasket. Provide matching roof curbs suitable for the roof slope. Curbs shall extend minimum 8 inches above roof surface. Units shall be capable of resisting wind load specified in 239110.

C. Coils: Evaporator coils, hot gas reheat coils and condenser coils shall be ½ inch seamless copper tubes mechanically expanded with aluminum fins, 16 gauge galvanized steel casing and end plates with plated hardware. Coils shall be factory leak tested at minimum 400 psig air pressure in a water bath. Evaporator coils shall be minimum six rows deep with maximum air velocity of 500 fpm. Provide a sloped, self-draining IAQ drain pan under the entire evaporator coil. The pan shall be 20-gauge stainless steel. Hot gas reheat coils shall be factory-installed.

D. Refrigerant System: Compressors shall be the inverter scroll type, suction gas cooled, suitable for HFC refrigerant, equipped with internal thermal protection, service valves and resilient type external mounting. The refrigerant circuit shall have an in-line solder type liquid line filter drier, liquid and moisture indicator, hot gas bypass, suction accumulator, receiver with pressure relief valve set at 400 psig and a thermostatic expansion valve. Tamper-proof, hermetically sealed, non-adjustable high and low pressure controls and service valves shall be installed using Schraeder type valves. Factory charge with HFC refrigerant.

E. Condenser Fan Section: Condenser fans shall be of the direct-driven propeller type, mounted for vertical air discharge. Fans shall low-sound type with ECM lead fan for modulating head pressure control. The motor shall be inherently protected permanently lubricated with sealed ball bearings and built-in overload protection. Condenser coil guard shall be heavy gauge welded steel with baked-on epoxy coating.

F. Evaporator Fan Section: The evaporator supply fan shall be forward curved or plenum belt-driven type DWDI mounted on a solid steel shaft supported by sealed ball bearings. Fan drive shall be belt driven type with adjustable speed motor pulley. Fan shall be statically and dynamically balanced and tested. Provide grease-lubricated, self–aligning ball bearings with

200,000 hours average life. The motor shall be an open drip-proof, induction type with class B insulation and adjustable base.

G. Filters: Return air filters shall be the pleated type, minimum MERV 7. Provide an aluminum channel frame with drain holes. Velocity shall not exceed 500 fpm. Filters shall conform to SCCPSS approved sizes. Contact SCCPSS Facility Department for approved list.

H. Electric Resistance Heater: Unit shall be equipped with a factory mounted and wired auxiliary electric heating coil with capacity as scheduled. Heating elements shall be the nickel-chromium resistance wire type supported on ceramic bushings. Power wiring for coil is to be integral to the unit for a single point power connection. Provide airflow switches, contactors and fusing (as required). Built-in controls shall be supplied with the heater as integral and pre-wired components, contactors, fused control transformer, pressure differential switch, power supply terminals, thermal overheat protection, and solid state current modulating control (SCR).

I. Energy Recovery Section: The unit shall have a factory mounted and tested energy recovery wheel mounted in a rigid frame containing the wheel drive motor, drive belt, wheel seals and bearings. The wheel shall be rated in accordance with ARI 1060 and shall bear the ARI certification symbol. The wheel shall be constructed of light weight polymer material with permanently bonded desiccant coating. Wheel media shall be cleanable using hot water or light detergent without degrading the efficiency. The exhaust fan shall be the backward inclined type. Fan and motor shall be dynamically balanced. Include a backdraft damper and 4 inch thick, pleated, disposable outside air filters.

J. Makeup Air Damper: Provide a factory-installed, parallel blade, two-position motorized damper. Damper operation shall be as specified in section 238310.

K. Recirculating Damper: Provide factory-installed damper to allow recirculation of exhaust air back through unit and by-pass exhausting air. Recirculating damper will allow return air to be cycled through unit during building unoccupied times of year.

L. HVAC drain piping shall be schedule 40 PVC pipe with socket type fittings and solvent cement joints. Piping exposed above the roof shall receive two coats of white latex paint for UV protection. Provide non-penetrating neoprene roof pedestal pipe supports with clamps on maximum five foot spacing.

M. Controls: The control panel shall be built-in within a separate compartment not in the supply airstream. Fan motors and compressor motors shall be controlled by contactors and shall be protected with solid state adjustable trip overloads. Provide a low enthalpy cut-out, auxiliary heating control interlock, condenser fan motor low ambient control, and built-in cool/reheat outdoor air thermostat. An auto-reset voltage monitor shall be provided to shut down electrical system in response to temporary voltage fluctuation or phase loss. Provide a power block terminal and dry contacts for alarm and fan interlock. Connections shall be provided for remote enable/disable control and smoke detector shutdown. All wires shall be in a wire duct. Compressors shall have a time delay relay to prevent short-cycling. Provide a built-in airflow measuring station to continuously report airflow cfm to the internal controls.

N. Control Sequences: ERV units will operate on factory controls to stage compressors, fans, electric heaters, hot gas reheat, enthalpy wheels, etc. The unit will have a full BACnet

interface to EMCS in section 238310.

1. Occupied Mode: The supply fan and exhaust fan shall run continuously during Occupied Mode. Occupied Mode shall be initiated by EMCS signal.
2. Unoccupied Mode: The ERV will provide dehumidification during Unoccupied Mode. The outside air damper shall close and the ERV shall operate with 100% recirculation. A duct relative humidity sensor shall be installed at the unit return air connection. When return air relative humidity rises above 60%rh (adj.), the cooling coil shall run to deliver 55°F supply air. When the return air relative humidity falls back below 55%rh (adj.), the ERV shall shut off. The enthalpy wheel and exhaust fan shall be disabled during Unoccupied Mode. Unoccupied Mode shall be initiated by EMCS signal.
3. The unit shall shut down and generate an alarm upon receiving a smoke detector signal.
4. The unit shall shut down upon activation of building fire alarm.
5. The outside air damper shall be open during Occupied Mode and shall be closed during Unoccupied Mode. When Occupied Mode is enabled, the exhaust fan shall start only after the damper status has proven the damper is open. When Occupied Mode is disabled, the outside air damper shall close 4sec (adj.) after the supply fan stops.
6. Alarms shall be provided as follows:
   a. Supply / Exhaust Fan Failure: Commanded on, but the status is off.
   b. Supply / Exhaust Fan in Hand: Commanded off, but the status is on.
   c. Supply / Exhaust Fan Runtime Exceeded: Status runtime exceeds a user definable limit (adj.).
   d. Total Energy Wheel Rotation Failure: Commanded on, but the status is off.
   e. Total Energy Wheel in Hand: Commanded off, but the status is on.
   f. Total Energy Wheel Runtime Exceeded: Status runtime exceeds a user definable limit (adj.).
7. Cooling Mode: The cooling system shall run during Occupied Mode when the ambient dry bulb temperature exceeds 55°F. During cooling operation, the cooling coil discharge air temperature shall be controlled to maintain 55°F. Provide a temperature sensor downstream of the hot gas reheat coil. Hot gas reheat shall modulate to maintain setpoint at ERV space temperature sensors. The enthalpy wheel shall run when the ambient dry bulb temperature exceeds 65°F.
8. Heating Mode: The controller shall measure the supply air temperature and modulate the electric heater to maintain setpoint at ERV space temperature sensors. Heating shall be enabled whenever outside air temperature is lower than 55°F (adj.) and the fan status is on. The enthalpy wheel shall run when the ERV is in Heating Mode.
9. Filter Status: The controller shall monitor the status for outside air filter, supply air filter and exhaust air filter. Filter alarms shall be provided when differential pressure exceeds a user definable limit (adj.).
10. Supply Air Temperature: The controller shall monitor the supply air temperature. Alarms shall be provided for High Supply Air Temp (If the supply air temperature is greater than 120°F (adj.)) and Low Supply Air Temp (If the supply air temperature is less than 40°F (adj.)).

PART 3 - EXECUTION

3.1 INSPECTION:

A. Installer must examine areas and conditions under which units are to be installed and notify

the Contractor in writing of conditions detrimental to the proper completion of the work. Do not proceed with the work until the unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION:

A. Install units where shown, in accordance with equipment manufacturer's written instructions and recognized industry practices, to insure that units comply with requirements and serve intended purposes.

B. Coordinate with other work, including structural, ductwork, piping and electrical work as necessary to interface installation of ventilation units with other work. Control wiring, conduit and devices for complete, operable systems shall be provided and installed under the Mechanical specifications.

3.3 TESTING:

A. Upon completion of installation and connection to the completed air distribution system, start-up and test equipment in accordance with the manufacturer's recommendations. Operate units to demonstrate capability and compliance with requirements. Where possible, field-correct malfunctioning units, then retest to demonstrate compliance.

END OF SECTION 23 72 10

SECTION 23 72 20 - ENERGY RECOVERY VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

A. *RenewAire* is the Basis of Design manufacturer. Equivalent name brand equipment by *Carnes, Penn, Greenheck, Semco,* and *Valent* that meets performance, capacity, space, and other requirements of the design documents shall be acceptable.

B. Industry Standards:
   1. Comply with applicable provisions of *NFPA 90A* pertaining to construction and installation of air conditioning units.
   2. Comply with applicable provisions of *UL 465* and provide *UL* labels for electrical components.
   3. Units shall be rated and certified in accordance with applicable *ARI* and *ASHRAE Standards*.

1.3 SUBMITTALS:

A. Provide manufacturer's data, test reports, and product warranties.

PART 2 - PRODUCTS

2.1 ENERGY RECOVERY VENTILATORS:

A. Ventilator shall be a packaged type consisting of a cabinet, energy recovery wheel or core, exhaust fan, supply fan, motors, filters, and controls. The cabinet frame and panels shall be galvanized steel construction with sealed seams, hinged access panels, 1" rigid board internal insulation with foil facing tested to meet UL 181, and baked enamel finish. The cabinet shall have duct collars and be configured for suspended mounting or base mounting as indicated on the plans. Outdoor units shall have louvered weather hoods tested per AMCA Standard 500-L with corrugated mesh aluminum moisture eliminator. Exhaust outlet shall have an automatic backdraft damper. Provide combo roof curb with associated RAC suitable for the roof slope. Curbs shall extend minimum 8" above roof surface. Units shall be capable of resisting wind load specified in 239110.

B. Energy Recovery Wheel: Wheel shall be the enthalpy type for both sensible and latent heat recovery and be designed to ensure laminar flow. Energy transfer ratings must be *ARI*

Certified to Standard 1060 and bear the *ARI* certification symbol for *ARI Air-to-Air Energy Recovery Ventilation Equipment Certification Program based on ARI 1060*. Desiccant shall be silica gel permanently bonded to wheel media. Wheel shall be constructed of lightweight polymer material mounted in a stainless steel rotor. Wheels greater than 26" diameter shall have removable segments. Wheel drive belt shall be high strength urethane factory installed in a pre-stretched state. Provide a slide-out track for wheel maintenance.

C. Energy Recovery Core: Energy recovery core shall be of the total enthalpy type, capable of transferring both sensible and latent energy between airstreams. Latent energy transfer shall be accomplished by direct water vapor transfer from one airstream to the other, without exposing transfer media in succeeding cycles directly to the exhaust air and then to the fresh air. No condensate drains shall be allowed. The energy recovery core shall be designed and constructed to permit cleaning and removal for servicing. The energy recovery core shall have a ten year warranty. Performance criteria are to be as specified in AHRI Standard 1060.

D. Fans: Centrifugal fans shall be DWDI, single fan, forward curved type. Blower wheel shall be statically and dynamically balanced. Steel shafts shall be mounted in permanently lubricated, sealed ball bearing pillow blocks. Bearing life shall be minimum (L10) life in excess of 100,000 hours at maximum speed. Belt driven fans less than 10 hp shall have adjustable sheaves. Direct drive fans shall speed controllers. Provide neoprene isolators in fan base. Fans shall be in a draw-through position relative to the energy recovery wheel.

E. Motors and Drives: Motors shall comply with *EPACT* standards for single speed ODP and TE enclosures. Motors shall be permanently lubricated, heavy-duty type. Drives shall be sized for 150% of driven horsepower. Energy wheel motors and direct drive motors shall have integral overload protection.

F. Filters on the supply air and exhaust air shall be the pleated type. Supply air and exhaust air shall have 2" thick pleated MERV 13. Filters shall be listed by *UL* as Class 2. Initial resistance at 500 fpm velocity shall not exceed 0.30" wg. The media support shall be a welded wire grid. Provide dirty filter sensors with indicator lights. Provide wheel rotation sensor with indicator light. Filters shall conform to SCCPSS approved sizes. Contact SCCPSS Facility Department for approved list.

G. Electrical: All internal electrical components shall be factory wired for single point power connection. All electrical components shall be *UL* listed, approved or classified where applicable and wired per *NEC*. Provide weatherproof disconnect switch and motor starters. Control box shall include motor starters, control circuit fusing, control transformer for 24 VAC circuit. Provide dirty filter sensors and wheel rotation sensor with indicator light.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install ventilators in accordance with the manufacturer's instructions. Each ERV shall be interlocked with its associated air handler.

B. The mounting height of each wall mounted thermostat or temperature sensor shall comply

with ADA for maximum side reach. The thermostat or sensor shall be at 48" maximum above the floor.

END OF SECTION 23 72 20

SECTION 23 83 10 - ENERGY MANAGEMENT AND CONTROL SYSTEM

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. Furnish and install all necessary software and hardware, wiring, and computing equipment in compliance with this specification. Any variances from this specification or related documentation shall be submitted in writing at the time of bid.

B. System Requirements:
   1. Standard Material/Products. All material and equipment used shall be standard components, regularly manufactured and available, and not custom designed especially for this project.
   2. Modular Design. The system architecture shall be fully modular permitting expansion of application software, system peripherals, and field hardware.
   3. Performance. The system, upon completion of the installation and prior to acceptance of the project, shall perform all operating functions as detailed in this specification.

C. Equipment:
   1. System Hardware: Provide the following:
      a. PC's, PDA's, server(s), routers, modems and control modules as specified.
      b. All sensing devices, relays, switches, indicating devices, and transducers required to perform the functions as listed in I/O Summary Tables.
      c. All monitoring and control wiring.
   2. System Software: Provide all software identified in Part 2 of this specification, including the EMCS Server, fully configured database, graphics, reports, alarm/events. The Graphical User Interface (GUI) shall be completely Web based as specified herein.
   3. Acceptable Manufacturers: *Automated Logic Corporation / ALC Controls* and *Siemens Desigo*.

1.2 GENERAL CONDITIONS:

A. Changes in Scope of Work: Any changes in the scope of work must be authorized by a written Change Order.

B. Correction of Work:
   1. Promptly correct all work Architect/Engineer finds defective or failing to conform to the Contract Documents and bear all cost of correcting such work.
   2. During Warranty. If, within the warranty period required by the Contract Documents, any of the work is found to be defective or not in accordance with the Contract Documents, correct it promptly after receipt of a written notice from Architect/Engineer to do so. Architect/Engineer shall give notice promptly after discovery of the condition.

C. Coordination of Work During Construction: Coordinate any necessary changes in work scheduling with Architect/Engineer to minimize disruption. Coordinate with and protect the

installed works by other trades. Repair any damage caused by his work to building(s) and equipment at no additional cost to the owner.

D. Warranty: Warrant, from the date of final acceptance by Architect/Engineer, that all systems, subsystems, component parts, and software are fully free from defective design, materials, and workmanship for a period of one year.

1.3 SUBMITTALS, DOCUMENTATION, ACCEPTANCE AND TRAINING

A. Submittals:
   1. Shop Drawings. A minimum of four (6) copies of shop drawings shall be submitted and shall consist of a complete list of equipment, materials, manufacturer's technical literature, cut-sheets, and installation instructions. Drawings shall contain proposed layout, complete wiring, routing, schematic diagrams, tag number of devices, software descriptions, calculations, installation details, and any other details required to demonstrate that the system will function properly.
   2. Graphical Programming Documentation: Provide a printout all Graphical Programs, identifying the specific HVAC or mechanical/electrical subsystem being controlled
   3. Drawing Approval: Shop drawings shall be approved before any equipment is installed. Allow a minimum of fourteen (14) days for drawing approval.
   4. As Built Drawings. All drawings shall be reviewed after the final system checkout and updated or corrected to provide 'as-built' drawings to show exact installation. All shop drawings will be acknowledged in writing by Architect/Engineer before installation is started and again after the final checkout of the system. The system will not be considered complete until the 'as-built' drawings have received their final approval. Deliver 2 sets of 'as-built' drawings.

B. Documentation: Operating and Maintenance (O&M) manuals for the system shall be made available electronically using Acrobat 4.x (PDF) format and include the following categories: Workstation User's Manual, Project Engineering Handbook, Software Documentation.

   1. EMCS User's Manual shall contain as a minimum:
      a. System overview.
      b. Networking concepts.
      c. Launching a web browser from a networked PC/PDA and login.
      d. Graphical User Interface (GUI) screen menus and their definitions.
      e. Creating, modifying or deleting schedules.
      f. Uploading and downloading software to the field hardware.
      g. Creating historical trends, collecting trend data and generating trend graphs.
      h. Enabling and assigning alarms and messages to reporting actions/groups.
      i. Report generation and ‘third party software’.
      j. Backing up software and data files.

   2. Project Engineering Manual shall contain as a minimum:
      a. System architecture overview.
      b. Hardware cut-sheets and product descriptions.
      c. Deliver six (6) sets of 'as-built' drawings. All drawings shall be reviewed after the final system checkout and updated to provide 'as-built' drawings. The system will not be considered complete until the 'as-built' drawings have received their final approval.

d. Installation, mounting and connection details for all field hardware and accessories.
e. Commissioning, setup and backup procedures for all control modules/accessories, EMCS server software, and database.
f. Listing of basic terminology, alarms/messages, error messages and frequently used commands or shortcuts.

3. EMCS Software Documentation shall contain as a minimum:
   a. Provide a printout all Graphical Programs, detailing their application to specific HVAC equipment and electrical/mechanical subsystems, together with a glossary or icon symbol library detailing the function of each graphical icon. Revisions made as a result of the submittal process, during the installation, start-up or acceptance portion of the project, shall be accurately reflected in the "as-builts".
   b. Graphical representation of the mechanical equipment hierarchy for the project including all equipment controlled by the EMCS.
   c. Detailed listing of all alarm and event messages programmed for designated mechanical/electrical equipment and required operator action.

C. System Training: System Use Instructions: Provide full Computer Based Training (CBT) in addition to training of designated personnel in the operation, maintenance, and programming of the system. All training sessions shall be digitally recorded (audio/video) and submitted to the Owner.

PART 2 – PRODUCTS

2.1 SYSTEM OVERVIEW:

A. The existing server communicates using ASHRAE's BACnet/IP protocol, and in addition, offer concurrent support over the same data-link of the following protocols: LonWorks and SNMP. Server shall be accessed using a web browser over the DDC system Intranet provided under this contract and remotely over the Internet. Third party manufactured and developed EMCS software is not acceptable.

B. The web browser GUI shall provide a completely interactive user interface and must offer the following features as a minimum:
   1. Trending.
   2. Scheduling.
   3. Downloading Memory to field devices.
   4. Real time 'live' Graphic Program Diagnostics for troubleshooting.
   5. Tree Navigation.
   6. Parameter change of properties.
   7. Setpoint Adjustments.
   8. Alarm / Event information.
   9. Configuration of operators.
   10. Execution of global commands.

C. Thin Client – Web Browser Based: The GUI shall be thin client or browser based and shall meet the following criteria:

1. Web Browser's for PC's: Only a 6.x browser (Explorer/Navigator) will be required as the GUI, and a valid connection to the server network. No installation of any custom software shall be required on the operator's GUI workstation/client. Connection shall be over an intranet or the Internet. A firewall shall be installed (as necessary) to protect the customer's Intranet.
2. Secure Socket Layers: Communication between the Web Browser GUI and BAS server shall be encrypted using 128-bit encryption technology within Secure Socket Layers (SSL). Communication protocol shall be Hyper-Text Transfer Protocol (HTTP).
3. PDA's: EMCS Server software must support other browsers used by Personal Digital Assistants like 3Com Palm Pilots and other Internet appliances specified herein.

2.2 WEB BROWSER GRAPHICAL USER INTERFACE – LGR:

A. Web Browser Navigation: The Thin Client web browser GUI shall provide a comprehensive user interface. Using a collection of web pages, it shall be constructed to "feel" like a single application, and provide a complete and intuitive mouse/menu driven operator interface. It shall be possible to navigate through the system using a web browser. The Web Browser GUI shall (as a minimum) provide a Navigation Pane for navigation, and a Action Pane for display of animated graphics, schedules, alarms/events, live graphic programs, active graphic setpoint controls, configuration menus for operator access, reports, and reporting actions for events.

1. Log-in: On launching the web browser and selecting the appropriate domain name or IP address, the operator shall be presented with a login page that will require a login name and password. Navigation in the system shall be dependent on the operator's role privileges, and geographic area of responsibility (see 3.2 J below).

2. Navigation Pane: The Navigation Pane shall comprise a Navigation Tree which defines a geographic hierarchy of the proposed EMCS system. Navigation through the GUI shall be accomplished by clicking on appropriate level of a navigation tree (consisting of expandable and collapsible tree control like Microsoft's Explorer program), and/or by selecting dynamic links to other system graphics. Both the navigation tree and graphic pane defined in 2.2 D shall be displayed simultaneously, enabling the operator to select a specific system or equipment, and view the graphic corresponding to the highlighted position in the navigation tree. The navigation tree shall as a minimum provide the following views: Geographic, Network, Groups and Configuration.

   a. Geographic View shall display a logical geographic hierarchy of the system including cities, sites, buildings, building systems, floors, equipment and BACnet objects.
   b. Network View shall display the hierarchy of the actual BACnet IP Intranet network. This can include Systems, Site, Networks, Routers, Half-Routers, Devices, Equipment and all the BACnet Objects in a device.
   c. Groups View shall display Scheduled Groups and custom reports.
   d. Configuration View shall display all the configuration categories (Operators, Schedule, Event, Reporting and Roles).

3. Action Pane: The Action Pane shall provide several functional views for each HVAC or mechanical/electrical subsystem specified. By clicking on a button, an operator shall be able to select the following system page, corresponding to the highlighted area/equipment in the navigation tree:

a. Graphics: Using animated gifs or other graphical format suitable for display in a web browser, graphics shall include aerial building/campus views, color building floor-plans, equipment drawings of each individual piece of equipment with live variable statuses, active graphic setpoint controls, web content, and other valid HTML elements. The data on each graphic page shall automatically refresh at a rate defined by the operator.
b. Properties: Shall include graphic controls and text for the following: Locking or overriding BACnet objects, demand strategies, and any other valid data required for setup. Changes made to the properties pages shall require the operator to depress a 'accept/cancel' button.
c. Schedules: Shall be used to create, modify/edit and view schedules based on the systems geographical hierarchy (using the navigation tree) and in compliance with section 2.2.G
d. Events: Shall be used to view alarm event information geographically (using the navigation tree), acknowledge events, sort events by category, actions and verify reporting actions.
e. Trends: Shall be used to display associated trend and historical data, modify colors, date range, axis and scaling
f. Logic - Live Graphic Programs: Shall be used to display a 'live' graphic programs of the control algorithm for the mechanical/electrical system selected in the navigation tree. All control outputs and inputs shall displayed on the program giving real-time statuses for use in operator troubleshooting.

B. The Web Browser GUI shall make extensive use of color in the graphic pane to communicate information related to setpoints and comfort. Animated gif's, active setpoint graphic controls and valid web content (like local weather forecast) shall be used to enhance usability:

1. Display Size: The GUI workstation software shall graphically display in 1024 by 768 pixels 24 bit True Color.
2. General Graphic: General area maps shall show locations of controlled buildings in relation to local landmarks.
3. Color Floor Plans: Floor plan graphics shall show heating and cooling zones throughout the buildings in a range of colors, which provide a visual display of temperature relative to their respective setpoints (see section 3.2 F below). The colors shall be updated dynamically as a zone's actual comfort condition changes in real-time. Locations of space sensors shall also be shown for each zone. The intent of the specification is to enable the operator to readily assess problems at a glance.
4. Mechanical Components: Mechanical system graphics shall show the type of mechanical system components serving any zone through the use of a pictorial representation of components. Selected I/O points being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Animation shall be used for rotation or moving mechanical components to enhance usability.
5. Minimum System Color Graphics: Color graphics shall be selected and displayed via a web browser for the following:
   a. Each piece of equipment monitored or controlled.
   b. Each building.
   c. Each floor and zone controlled.
   d. Zone Setpoint Adjustments.

C. Hierarchical Schedules: Utilizing the Navigation Tree displayed in the web browser GUI, an operator (with password access) shall be able to define a Normal, Holiday or Override schedule for an individual piece of equipment or room, or choose to apply a hierarchical schedule to the entire system, site or floor area. All schedules that affect the system/area/equipment highlighted in the Navigation Tree shall be shown in a summary schedule table and graph.
   1. BACnet Schedules: Schedules shall comply with the BACnet standard, (Schedule Object, Calendar Object, Weekly Schedule property and Exception Schedule property) and shall allow events to be scheduled based on:
      a. Types of schedule shall be Normal, Holiday or Override.
      b. A specific date.
      c. A range of dates.
      d. Any combination of Month of Year (1-12, any), Week of Month (1-5, last, any), Day of Week (M-Sun, Any).
      e. Wildcard (example, allow combinations like second Tuesday of every month).
   2. Schedule Categories: The system shall allow operators to define and edit scheduling categories (different types of "things" to be scheduled; for example, lighting, HVAC occupancy, etc.). The categories shall include name, description, icon (to display in the hierarchy tree when icon option is selected) and type of value to be scheduled.
   3. Schedule Groups: In addition to hierarchical scheduling, operators shall be able to define functional Schedule Groups, comprised of an arbitrary group of areas/rooms/equipment scattered throughout the facility and site. For example, the operator shall be able to define an 'individual tenant' group – who may occupy different areas within a building or buildings. Schedules applied to the 'tenant group' shall automatically be downloaded to control modules affecting spaces occupied by the 'tenant group'
   4. Intelligent Scheduling: The control system shall be intelligent enough to automatically turn on any supporting equipment needed to control the environment in an occupied space.
   5. Partial Day Exceptions: Schedule events shall be able to accommodate a time range specified by the operator.
   6. Schedule Summary Graph: The schedule summary graph shall clearly show Normal versus Holiday versus Override Schedules, and the net operating schedule that results from all contributing schedules. Note: In case of priority conflict between schedules at the different geographic hierarchy, the schedule for the more detailed geographic level shall apply.
   7. Schedule Distribution: For reliability and performance, instead of maintaining a single schedule in a field device that writes over the network to notify other devices when a scheduled event occurs, field devices will only keep their part of the schedule locally. The EMCS server software shall determine which nodes a hierarchical schedule applies to and will create/modify the necessary schedule objects in each field device as necessary.

D. Events (& Alarms): Events and alarms associated with a specific system, area, or equipment selected in the Navigation Tree, shall be displayed in the Action Pane by selecting an 'Events' view. Events, alarms, and reporting actions shall have the following capabilities:
   1. Events View: Each event shall display an Event Category (using a different icon for each event category), date/time of occurrence, current status, event report, and a URL link to the associated graphic for the selected system, area or equipment. The URL link shall indicate the system location, address and other pertinent information. An operator shall easily be able to sort events, edit event templates and categories, acknowledge or force a return to normal in the Events View as specified in this section.
   2. Event Categories: The operator shall be able to create, edit or delete event categories such as HVAC, Maintenance, Fire, or Generator. An icon shall be associated with each Event

category, enabling the operator to easily sort through multiple events displayed using a built-in filter.

3. BACnet Event Templates: BACnet Event template shall define different types of alarms and their associated properties. As a minimum, properties shall include a reference name, verbose description, severity of event, acknowledgement requirements, high/low limit and out of range information.
4. Event Areas: Event Areas enable an operator to assign specific Event Categories to specific Event Reporting Actions.
5. Event Time/Date Stamp: All events shall be generated at the DDC control module level and comprise the Time/Date Stamp using the standalone control module time and date.
6. Event Configuration: Operators shall be able to define the type of events generated per BACnet object. A 'network' view of the Navigation Tree shall expose all BACnet objects and their respective Event Configuration. Configuration shall include assignment of event, alarm, type of Acknowledgement and notification for return to normal or fault status.
7. Event Summary Counter: The view of events in the Graphic Pane shall provide a numeric counter, indicating how many events are active (in alarm), require acknowledgement, and total number of events in the EMCS Server database.
8. Persistent Data. The system shall allow for external systems to access the event instance data. Event data shall be stored and queried in the database in a relational manner. At a minimum, the fields to be stored in the database are:
    - Event Source
    - Event Generation Time
    - Acknowledge Required Flag
    - Delivery Priority
    - BACnet Event Type
    - Event Message Text
    - BACnet Event Parameter
    - Classification of Event
    - Event Acknowledgement Time
    - Return to Normal Time
    - Operator Comments
    - Who Acknowledged the Event
9. Event Auto-Deletion: Events that are acknowledged and closed shall be auto-deleted from the database and archived to a text file after an operator defined period.
10. Event Reporting Actions: Event Reporting Actions specified shall be automatically launched (under operator defined conditions) after an event is received by the EMCS server software. Operators shall be able to fully define these Reporting Actions using the Navigation Tree and Graphic Pane in the web browser GUI. Reporting Actions shall be as follows:
    a. Print: Alarm/Event information shall be printed to the EMCS server's PC or a networked printer.
    b. Email: Email shall be sent via any POP3-compatible e-mail server (most Internet Service Providers use POP3). Email messages may be copied to several email accounts.

E. Trends: Trends shall conform to the BACnet Trend Log Object specification. The system shall be able to trend and display graphically all analog, digital or calculated points simultaneously. A trend log's properties shall be editable using the Navigation Tree and Graphic Pane.
    1. Viewing Trends: The operator shall have the ability to view trends by using the Navigation Tree and selecting a Trends button in the Graphic Pane. The system shall allow y- and x-axis maximum ranges to be specified and shall be able to simultaneously graphically display multiple trends per graph.

2. Local Trends: Trend data shall be collected locally by Multi-Equipment/Single Equipment general-purpose controllers, and periodically uploaded to the BAS server if historical trending is enabled for the BACnet object. Trend data, including run time hours and start time date shall be retained in non-volatile module memory
3. Resolution. Sample intervals shall be as small as one (0.1) second. Each trended point will have the ability to be trended at a different trend interval. When multiple points are selected for display that have different trend intervals, the system will automatically scale the axis.
4. Dynamic Update. Trends shall be able to dynamically update at operator-defined intervals.
5. Zoom. It shall be possible to zoom-in on a particular section of a trend for more detailed examination.
6. Numeric Value Display. It shall be possible to pick any sample on a trend and have the numerical value displayed.

F. Security Access: Systems that Security access from the web browser GUI to EMCS server shall require a Login Name and Password. Access to different areas of the EMCS system shall be defined in terms of Roles, Privileges and geographic area of responsibility. Roles shall be geographically assigned using a similar expandable/collapsible navigation tree.

2.3 GRAPHICAL PROGRAMMING:

A. The system software shall include a Graphic Programming Language (GPL) for all DDC control algorithms resident in standalone control modules. Any system that does not use a drag and drop method of graphical icon programming as described herein shall be unacceptable. GPL is a method used to create a sequence of operations by assembling graphic microblocks that represent each of the commands or functions necessary to complete a control sequence of operation. Microblocks represent common logical control devices used in conventional control systems, such as relays, switches, high signal selectors, etc., in addition to the more complex DDC and energy management strategies such as PID loops and optimum start. Each microblock shall be interactive and contain the programming necessary to execute the function of the device it represents.

B. Graphic programming shall be performed while on screen and using a mouse; each microblock shall be selected from a microblock library and assembled with other microblocks necessary to complete the specified sequence. Microblocks are then interconnected on screen using graphic "wires," each forming a logical connection. Once assembled, each logical grouping of microblocks and their interconnecting wires then forms a graphic function block which may be used to control any piece of equipment with a similar point configuration and sequence of operation.

C. Simulation: Full simulation capability shall be provided with the graphic programming. Operator shall be able to fully simulate the constructed control sequence prior to downloading into field control modules. Simulation capabilities shall include step-by-step, accelerated time, and operator defined simulation criteria like outside weather, demand, and communication status.

D. GPL Capabilities: The following is a minimum definition of the capabilities of the Graphic Programming software:

1. Function Block (FB): Shall be a collection of points, microblocks and wires which have been connected together for the specific purpose of controlling a piece of HVAC equipment or a single mechanical system.
2. Logical I/O: Input/Output points shall interface with the control modules in order to read various signals and/or values or to transmit signal or values to controlled devices.
3. BACnet Points: Shall be points that comply with the BACnet structure as defined in the BIBB's Addendum B1/B2, and the BACnet standard.
4. Microblocks: Shall be software devices that are represented graphically and may be connected together to perform a specified sequence. A library of microblocks shall be submitted with the control contractors bid.
5. Wires: Shall be graphical elements used to form logical connections between microblocks and between logical I/O. Different wire types shall be used depending on whether the signal they conduct is analog or digital.
6. Labels: Labels shall be similar to wires in that they are used to form logical connections between two points. Labels shall form a connection by reference instead of a visual connection; i.e. two points labeled 'A' on a drawing are logically connected even though there is no wire between them.
7. Parameter: A parameter shall be a value that may be tied to the input of a microblock.
8. Properties: Dialog boxes shall appear after a microblock has been inserted which has editable parameters associated with it. Default parameter dialog boxes shall contain various editable and non-editable fields and shall contain 'push buttons' for the purpose of selecting default parameter settings.
9. Icon: An icon shall be graphic representation of a software program. Each graphic microblock has an icon associated with it that graphically describes it function.
10. Menu-bar Icon: Shall be an icon that is displayed on the menu bar on the GPL screen, which represents its associated graphic microblock.

2.4 HARDWARE:

A. Input Devices:

1. Sensors:
   a. Sensors used for mixed air application shall be the averaging type and have an accuracy of +1°F.
   b. Room temperature sensors shall have an accuracy of +0.25°F in the range of 45°F to 96°F. Room sensors shall have built-in local setpoint adjustment and timed push-button override. Provide a manual slide lever for temperature adjustment with temperature selection sticker divided into a blue area and red area. Lever movement toward blue increases cooling. Lever movement toward red increases heating.
   c. Duct Temperature Sensors: Duct Temperature Sensors shall be 1000-ohm single point or averaging type as need. Averaging sensors shall be RTDs, or 10,000-ohm averaging thermistors. Single point sensors shall be 5,000 ohm or 10,000-ohm thermistors.
   d. Outside Air Sensors: Outside Air Sensor shall be 5,000 or 10,000-ohm thermistor, with integral PVC housing and ½" NPT conduit connector.
   e. Space and Duct Relative Humidity Sensors: Space Relative Humidity Sensors shall and have a range of 0-100% RH. The measuring accuracy shall be 2%. Where temperature sensors and RH sensors are shown side-by-side, a single combination sensor shall be provided.

2. Pressure Instruments:
   a. Sensors shall have a 4-20 MA output proportional signal with provisions for field checking. Sensors shall withstand up to 150% of rated pressure, without damaging the device. Accuracy shall be within +2% of full scale. Sensors shall be manufactured by Leeds & Northrup, Setra, Robertshaw, Dwyer Instruments, Rosemont, or be approved equal.
   b. Pressure switches shall have a repetitive accuracy of +2% of range and withstand up to 150% of rated pressure. Sensors shall be diaphragm or bourdon tube design. Switch operation shall be adjustable over the operating pressure range. The switch shall have an application rated Form C, snap-acting, self-wiping contact of platinum alloy, silver alloy, or gold plating.

3. Watt-hour Transducers: Watt-hour transducers shall have an accuracy of +0.25% for kW and kWh outputs from full lag to full lead power factor. Input ranges for kW and kWh transducers shall be selectable without requiring the changing of current or potential transformers, and shall have dry contact pulse accumulation.

4. Voltage-to-Digital Alarm Relays: Relays shall monitor status of boiler or chiller safeties and overloads and shall be sized and connected so as not to impede the function of the monitored contacts. Switch shall have self-wiping, snap-acting Form C contacts rated for the application.

5. Current Sensing Relays: Relays shall monitor status of motor loads. Switch shall have self-wiping, snap-acting Form C contacts rated for the application. The setpoint of the contact operation shall be field adjustable.

6. Duct Smoke Detectors: Ionization type air duct smoke detectors shall be furnished as specified elsewhere by Division 27 for installation under Division 23. All Fire Alarm System wiring for air duct detectors shall be furnished and installed under Division 27. All EMCS wiring for air duct detectors shall be furnished and installed under this section.

7. Provide a Master HVAC System Shutdown Switch in the Administration area where shown on the plans. The manual switch shall shut down all HVAC equipment in the building. HVAC systems shall automatically restart when switch is turned back ‘ON.’

B. Output Devices:

1. Control Relays: Control relay contacts shall be rated for 150% of the loading application, with self-wiping, snap-acting Form C contacts, enclosed in dustproof enclosure. Relays shall have silver cadmium contacts with a minimum life span rating of one million operations. Relays shall be equipped with coil transient suppression devices.

2. Solid State Relays (SSR): Input/output isolation shall be greater than 10 billion ohms with a breakdown voltage of 15 V root mean square, or greater, at 60 Hz. The contact operating life shall be 10 million operations or greater. The ambient temperature range of SSRs shall be 20°F-140°F. Input impedance shall be greater than 500 ohms. Relays shall be rated for the application. Operating and release time shall be 10 milliseconds or less. Transient suppression shall be provided as an integral part of the relays.

PART 3 – APPLICATION SOFTWARE

3.1 GENERAL: The following applications software shall be provided for the purpose of optimizing energy consumption while maintaining occupant comfort:

A. Time of Day Scheduling (TOD)

B. Optimum Start/Stop (OSS)/Optimum Enable/Disable (OED)

C. Source Temperature Optimization (STO)

D. Demand Limiting (DL) - Temperature Compensated

E. Day/Night Setback (DNS)

F. Timed Local Override (TLO)

G. Space Temperature Control (STC)

PART 4 – SEQUENCE OF CONTROL

4.1 GENERAL:

A. Following are the typical sequences of operation for mechanical equipment. Within each section, each paragraph describes a specific control sequence for a component of the equipment; start/stop, status, etc. Each specific control sequence will require appropriate I/O points.

4.2 ROOF AIR CONDITIONERS (RAC):

A. Roof Air Conditioners shall be controlled by space temperature and relative humidity sensors. During occupied hours, supply fans shall run continuously, outside air dampers shall be open, and cooling and heating modes shall cycle as needed to maintain space temperature setpoint.

B. During unoccupied hours, supply fans shall run intermittently and outside air dampers shall be closed.

C. The unit shall shut down and generate an alarm upon receiving an emergency shutdown signal.

D. The unit shall shut down and generate an alarm upon receiving a smoke detector status.

E. The unit shall shut down upon activation of building fire alarm.

F. Units shall operate in Dehumidification Mode whenever indoor relative humidity exceeds 55% (adjustable) and force the unit into full cooling until the indoor relative humidity falls below 50% (adjustable). During Dehumidification Mode, hot gas reheat shall operate to maintain the indoor

setpoint. Roof Air Conditioners serving gymnasiums with wood flooring shall have relative humidity setpoints adjusted as required by the wood flooring manufacturer's warranty documents.

G. Where scheduled on the plans, provide Staged Air Volume control.

H. Units shall operate in Economizer Mode whenever outside air temperature is less than 55°F (adj.) and the outside air temperature is less than the return air temperature and the supply fan status is on. The economizer shall close whenever mixed air temperature drops from 45°F to 40°F (adj.) or on loss of supply fan status. Controller shall measure the zone temperature and modulate the economizer dampers in sequence to maintain a setpoint 2°F less than the zone cooling setpoint.

I. For units with built-in ERV's, EMCS shall measure and monitor return air temperature, mixed air temperature, and wheel status.

J. Outdoor Air Control:
   1. All units except those noted below shall provide Occupied Mode OA CFM at constant 100% of scheduled value regardless of unit supply airflow.
   2. RAC-5, 6, 8: Occupied Mode OA CFM shall be constant 100% of scheduled minimum airflow value when space CO2 is less than 2000 ppm. OA CFM shall be constant 100% of scheduled maximum value when space CO2 is 2000 ppm and greater.

K. Provide full DDC control by EMCS.

4.3 VRF HEAT PUMPS:

A. Provide control of each air handler or cassette through the manufacturer provided thermostat control interface. Interface of unit into the EMCS shall permit full control and scheduling of unit and shall provide all sensed values to EMCS.

B. Units shall be stopped upon activation of building fire alarm.

C. Units shall be stopped upon activation of emergency shut-off switch in admin area.

D. In occupied mode, unit shall control to occupied heating and cooling setpoints. Unit heating and/or cooling shall be cycled to maintain comfort conditions. Fan speed shall be set to 'Auto'. Set vane control to fixed horizontal.

E. In unoccupied mode, unit shall control to unoccupied heating and cooling setpoints. Unit heating and/or cooling shall be cycled to maintain setback conditions.

F. Zone sensor shall provide an override button, which will place the system in occupied mode for a pre-determined time period if pressed while in unoccupied mode.

G. Zone sensor shall provide a bias adjustment lever. Gain for the adjustment lever shall be controllable through the building control system. Bias adjustment shall have no effect during unoccupied operation.

4.4 DUCTLESS HEAT PUMPS:

A. Provide control of each ductless air handler or cassette through the manufacturer provided thermostat control interface. Interface of unit into the building management system through the EMCS controller shall permit full control and scheduling of unit and shall provide all sensed values to EMCS.

B. Ductless systems shall run in response to room temperature setpoint.

4.5 ELECTRIC HEATERS:

A. Wall Heaters, Unit Heaters, and Cabinet Heaters shall be controlled by integral thermostats and shall not be connected to EMCS.

4.6 ENERGY RECOVERY VENTILATORS and DOAS:

A. ERV and DOAS units will be controlled by factory controls. All available points shall be integrated to the EMCS for monitoring and alarms.

B. EMCS shall provide signals for Occupied Mode and Unoccupied Mode.

C. EMCS shall provide smoke detector shutdown signal.

D. Air temperature points, wheel rotation status, fan status, compressor status, filter status, operation modes and alarm points shall be included on EMCS graphics.

4.7 SPACE TEMPERATURE CONTROL:

A. Space Temperature Measurement: There shall be two space temperature setpoints, one for cooling and one for heating, separated by a dead band. Only one of the two setpoints shall be operative at any time.

B. The cooling setpoint is operative if the actual space temperature has more recently been equal to or greater that the cooling setpoint. The heating setpoint is operative if the actual space temperature has more recently been equal to or less than the heating setpoint.

C. There are two modes of operation for the setpoints, one for the occupied mode (example: heating = 72 degrees F, cooling = 74 degrees F) and one for the unoccupied mode (example: heating = 65 degrees F, cooling = 85 degrees F).

D. The occupied/unoccupied modes may be scheduled by time, date, or day of week.

E. Provide remote temperature setpoint limiting.

F. Provide dynamic color graphics indicative of space temperature relative to setpoint.

4.8 EXHAUST FAN CONTROL:

A. KEF-1 shall be interlocked with the Kitchen Hood Demand Control Ventilation System furnished with the kitchen hood.

B. KEF-2 and KEF-3 shall be interlocked with pizza oven hoods.

C. EMCS Control: Fans scheduled to be “EMCS CONTROL” shall be controlled by EMCS to run continuously during Occupied Mode and be off during Unoccupied Mode. EMCS shall monitor fan status and generate an alarm for fan failure.

D. Wall Switch: Fans scheduled to be “WALL SWITCH CONTROL” shall be controlled by a wall mounted pushbutton time-delay switch labeled “Emergency Exhaust”. Wall switch shall have a maximum runtime of 10 minutes (adjustable).

E. Thermostat Control: Fans scheduled to be “THERMOSTAT CONTROL” shall be controlled by wall mounted temperature sensors. EMCS shall monitor space temperature and fan status.

F. Interlock w/ Lights: Fans scheduled to be “INTERLOCK W/ LIGHTS” shall be interlocked with the light switch and shall not be monitored by EMCS.

G. Interlock w/ Fume Hood: Fans scheduled to be “INTERLOCK W/ FUME HOOD” shall be interlocked with the fume hood switch and EMCS shall monitor fan status and generate an alarm for fan failure.

H. Interlock w/ Dryer: Fans scheduled to be “INTERLOCK W/ DRYER” shall be interlocked with the residential dryer and EMCS shall monitor fan status and generate an alarm for fan failure.

4.10 MISCELLANEOUS CONTROL:

A. Provide monitoring and alarm of kitchen freezer and cooler temperatures. See Section 114100.

B. Provide enable/disable for domestic water heaters and associated recirculating pumps.

C. Provide electric meter pulse, water meter pulse, gas meter pulse, outside air temperature, outside air relative humidity, fire alarm control panel, security alarm panel.

4.11 POINTS LIST:

A. Roof Air Conditioners:

1. Unit Fan Start/Stop: DO
2. Unit Fan Status: DI
3. Compressor: DO
4. Compressor Status: DI
5. Hot Gas Reheat: DO
6. Gas Heat: DO

7. Gas Heat Status: DI
8. Supply Air Temperature: AI
9. Space Temperature: AI
10. Space Relative Humidity: AI
11. Air Treatment Status: DI
12. OA Damper: DO
13. OA Damper Status: DI
14. Smoke Detector: DI
15. Unit Alarms: DI

B. Energy Recovery Ventilators and DOAS:

1. All available BACnet points
2. Air Treatment Status: DI

C. VRF Systems:

1. VAH Fan Start/Stop: DO
2. VAH Fan Status: DI
3. Space Temperature: AI
4. Air Treatment Status: DI
5. All available BACnet points

D. Ductless Heat Pumps:

1. Unit Start/Stop: DO
2. Space Temperature: AI

E. Electric Heater Controlled By Temperature:

1. Fan Start/Stop: DO
2. Fan Status: DI
3. Space Temperature: AI

F. Exhaust Fans Controlled By EMCS:

1. Fan Start/Stop: DO
2. Fan Status: DI

G. Exhaust Fans Controlled By Temperature:

1. Fan Start/Stop: DO
2. Fan Status: DI
3. Space Temperature: AI

H. Domestic Water Heaters:

1. Water Heater Start/Stop: DO
2. Water Heater Status: DI
3. Recirc. Pump Start/Stop: DO

4. Recirc. Pump Status: DI
5. Tank Water Temperature: AI

I. Global Items:

1. Electric Meter Pulse: DI
2. Water Meter Pulse: DI
3. Gas Meter Pulse: DI
4. Outside Air Temperature: AI
5. Outside Air Relative Humidity: AI
6. Fire Alarm Control Panel: DI
7. Security System Panel: DI

END OF SECTION 238310

SECTION 23 91 10 - MECHANICAL SOUND, VIBRATION, WIND AND SEISMIC CONTROL

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. Furnish all labor, materials, tools and equipment and perform all work necessary to complete the installation of the mechanical sound, vibration, wind and seismic control systems required by these specifications and as detailed on the drawings.

B. All foundations and supports required for the installation of Division 23 equipment shall be furnished by the Division 23 contractor shall unless specifically specified otherwise.

C. The following criteria applies to all mechanical systems and components:

1. Wind Pressure Velocity: 147 MPH
2. Seismic Design Category: B
3. Importance Factor: 1.0

D. Based on the criteria listed above, no seismic restraints are required.

1.2 RELATED DOCUMENTS:

A. The drawings and general provisions of this division of the Contract, including the General and Special Conditions and Division 1 Specifications, apply to this Section.

1.3 QUALITY ASSURANCE:

A. Codes and Standards: The installation of the mechanical systems shall be installed in accordance with the following codes and standards.:

1. *2018 International Building Code* (IBC)
2. ASHRAE

B. The mechanical sound, vibration, and wind control equipment and products shall be sized and provided by the manufacturers listed below.

C. *Kinetics Noise Control* is the Basis of Design manufacturer. Equivalent name brand equipment by *AeroSonics, Aladdin*, *IAC Acoustics, Mason, MGM Products, Vibration Eliminator, Vibro-Acoustics* and *Vibration Mountings and Controls* that meets performance, capacity, space and other requirements of the design documents shall be acceptable.

D. The manufacturer and/or his representative shall select all vibration isolation products in-accordance with the Vibration Isolation Schedule listed in these specifications. All products shall provide the specified deflection as indicated based on the actual equipment weights and installation requirements of the approved equipment. The manufacturer shall provide

installation instructions for all provided isolators and wind restraints. Locations of vibration isolation products shall be coordinated with equipment details shown on the drawings and also as specified in these specifications for maximum support locations for piping and other equipment.

E. Submittals:

1. The contractor shall submit for approval by the engineer all products intended to be used to meet the requirements of these specifications. Submittal data shall include a proposed schedule for vibration isolation products, manufacturer's data and cut sheets of the specific vibration isolation or sound barrier materials. Proposed Vibration Isolation Schedule shall list all equipment specified to be isolated, the equipment weight, proposed isolator type or base type, number of isolators required, spring or isolator color, and deflection of the spring or vibration isolator based on the equipment weight.
2. The contractor shall submit for approval by the engineer, wind anchorage requirements for all equipment and curbs. Anchorage calculations shall be prepared by a registered engineer in the state where the project will be constructed. The engineer shall stamp calculations. Wind anchorage requirements shall be submitted for all curb mounted equipment and roof mounted equipment. Fasteners shall be selected and detailed for curb connections to the building structure and also for equipment connections to the curb. Calculations shall be based on the approved equipment for the project.

PART 2 - PRODUCTS

2.1 GENERAL:

A. All equipment shall be mounted or suspended from approved foundations and supports as specified herein or as detailed on the drawings.

B. The vibration isolation products and systems shall have a deflection as recommended by the manufacturer but not less than the deflection indicated in the Vibration Isolation Schedule.

2.2 ISOLATOR TYPES:

A. Type 2 - Floor Mounted Equipment: Vibration isolators shall be neoprene, molded from oil-resistant compounds. Isolators shall consist of two layers of neoprene material. Top and bottom surfaces of each layer shall have molded ribs. Each layer shall be separated by a 16 gauge galvanized steel load plate bonded to each neoprene layer to form a sandwich arrangement. Vibration isolator size shall be coordinated with the equipment supports. Minimum size shall be 2"x2".

B. Type 4 - Floor-Mounted Equipment: Vibration isolators shall be free standing, un-housed, laterally stable springs wound from high strength spring steel. Springs shall have a lateral stiffness greater than 0.8 times the rated vertical stiffness and shall be designed to provide up to 50% overload capacity. Springs shall be selected to provide operating static deflections shown on the Vibration Isolation Schedule or as indicated on the project documents. Springs shall be color coded or otherwise identified to indicate load capacity. In capacities up to 5,000 lbs., springs shall be replaceable. In capacities over 5,000 lbs., springs shall be welded to the

top and bottom load plate assemblies. Springs shall be assembled between a top and bottom steel load plate. The upper load plate shall be provided with steel leveling bolt lock nut and washer for attachment to the supported equipment. The lower load plate shall have a non-skid noise isolation pad bonded to the bottom and have provisions for bolting the isolator to the supporting structure.

C. Type 9 - Suspended Equipment, Piping and Ductwork: Vibration isolators shall be hangers consisting of a freestanding, laterally stable steel spring and elastomeric washer in series, assembled with load transfer plates in a stamped or welded steel bracket. Springs shall have a lateral stiffness greater than 0.8 times the rated vertical stiffness and shall be designed to provide up to 50% overload capacity.

2.3 BASES AND RAILS:

A. Type C - Roof Mounted Equipment Vibration Isolation Rails: Vibration isolation rails shall be extruded aluminum or G90 galvanized steel consisting of a lower support rail, upper support rail, steel springs located between the support rails and a continuous weatherproof seal located between the upper and lower support rails. Vibration isolation rails shall be fabricated and designed to be installed and secured on top of the equipment manufacturer's roof curb. Isolation rails shall provide continuous support for the roof-mounted equipment. Isolation rails shall be designed and engineered to provide isolation against casing radiated vibration and structure born vibration from rotating equipment. The steel springs shall consist of large diameter laterally stable steel springs that have a lateral stiffness greater than 1.0 times the rated vertical stiffness and shall be designed to provide up to 50% overload capacity. Isolation rails shall have seismic restraints fabricated and attached to the isolation rail assembly to resist the horizontal forces. Seismic restraints shall be certified by the manufacturer and stamped by a registered engineer. Isolation rail assemblies shall include supply and return duct block-outs as an integral part of the isolation rail assembly. Springs must be removable and adjustable without disturbing the roof while equipment is in place.

2.4 SOUND CONTROL PRODUCTS:

A. Duct Sound Attenuators:

1. Attenuators shall be double wall construction with the outer shell being fabricated from 22 gage galvanized steel and the inner shell fabricated from 24 gauge perforated galvanized steel. Interior steel partitions shall be double wall construction fabricated from 24 gauge perforated galvanized steel.
2. Acoustic fill material shall be installed between the inner and outer shell and also in the interior partitions. Acoustic fill shall be fiberglass.
3. Duct sound attenuators shall meet the fire hazard classification ratings in accordance with ASTM-E84. Fire hazard ratings shall be a flame spread of 25 and smoke development of 20.

B. Acoustical Sound Barrier:

1. Acoustic Sound Barrier shall be constructed of vinyl material with a reinforced fiberglass screen loaded with barium sulfate, 1.0 lb/sf. Tensile strength shall be 300 lb/inch and tear strength shall be 100 lbs/inch.

C. Acoustical Duct Wrap Barrier:

1. Acoustic Duct Wrap Barrier shall be fabricated of a composite material consisting of an acoustic barrier material bonded to a thin layer of aluminum foil on one side and a decoupling layer of fiberglass batting material. Acoustic Barrier material shall be 0.10" thick barium sulphate loaded limp vinyl with "K" value of 0.29, STC rating of 28 and nominal density of 1.0 lb/sf.

2.5 VIBRATION ISOLATION SCHEDULE FOR MECHANICAL SYSTEMS:

Equipment Type	Isolator Type	Base Type	Deflection
Vertical DOAS	Type 2	None	0.2"
Vertical DAH/VAH	Type 2	None	0.2"
Suspended VAH	Type 9	None	1.0"
In-line Suspended Fan	Type 9	None	1.0"
Roof Air Conditioner	Type 4	Type C	2.0"
Roof VHP	Type 2	Steel Frame	0.2"
Roof DHP	Type 2	Steel Frame	0.2"
Roof ERV	Type 4	Type C	2.0"
DEF-1	Type 4	Steel Frame	1.0"

PART 3 - EXECUTION

3.1 GENERAL:

A. If the equipment provided is not furnished with integral structural steel supports, mounting feet or lifting lugs, the contractor shall provide miscellaneous steel shapes as required to install or suspend the equipment and attach the vibration isolation or seismic restraints as specified herein.

B. Support steel shall include but not be limited to rails, brackets, angles, channels, and similar components.

C. All equipment specified to be isolated shall be installed and isolators shall be attached to the building structure or floor and the vibration isolators shall be adjusted and leveled so that the vibration isolators are performing properly.

D. All vibration isolation products and sound control products shall be installed as outlined in the manufacturer's printed installation instructions.

E. For equipment scheduled to receive external vibration isolation, all factory-installed internal vibration isolation shall be locked down.

END OF SECTION 23 91 10

SECTION 23 92 10 - MECHANICAL TESTING, ADJUSTING, BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE:

A. General: An independent test agency shall perform the TAB work as described herein. The agency shall have a minimum of 3 years of successful TAB experience on projects of similar size and scope. The name of the test agency and proof of satisfactory performance on 5 previous projects in the form of projects referenced shall be submitted to the Architect for approval within 30 days after receipt of the construction contract.

B. Test Agency: A firm with membership in the *Associated Air Balance Council* (AABC) or certified by the *National Environmental Balancing Bureau* (NEBB) in those testing and balancing disciplines similar to those required for this project, who is not the Installer of the system to be tested, and is otherwise independent of the project.

C. Compliance: Comply with AABC standards or NEBB *Procedural Standards for Testing-Adjusting-Balancing of Environmental Systems* as applicable to mechanical air systems and associated equipment apparatus.

D. Industry Standards: Comply with ASHRAE (*American Society for Heating, Refrigeration and Air Conditioning Engineers, Inc.*) recommendations pertaining to measurements, instruments, and testing, adjusting, and balancing except as otherwise indicated.

E. Pre-Qualified TAB Agencies: Subject to compliance with requirements, engage one of the following the following certified Test and Balance Agencies:
1. *Air Analysis of Atlanta*
2. *TAB Services*
3. *Commissioning Services LLC.*
4. *Thomas Balancing*
5. *Georgia Balance Company*
6. *Augusta Air Balance Company*
7. *Palmetto Air and Water Balance*

1.3 SUBMITTALS:

A. Submit name of TAB Agency for approval within 60 days after Notice to Proceed.

B. Submit 5 copies of a certified test report signed by the TAB supervisor who performed the TAB work. Test reports shall be submitted prior to the final inspection of mechanical work.

1. Include identification and types of instruments used and their most recent calibration date with submission of final test report.
2. In addition to Air Balance and operational data required to be submitted, the report shall include any observation of unusual noise or vibration observed and any malfunction of adjustable devices encountered during TAB work.

C. Submit AABC National Performance Guaranty or NEBB Certificate of Conformance Certification for the project.

1.4 JOB CONDITIONS:

A. Do not proceed with testing, adjusting and balancing work until mechanical systems are complete and operable. Do not proceed until systems are clean and free from debris, dirt, and discarded building materials.

PART 2 - PRODUCTS

2.1 PATCHING MATERIALS:

A. Except as otherwise indicated, use the same products as used by original Installer for patching holes in insulation, ductwork and housing which may have been cut or drilled for test purposes, including access for test instruments, attaching jigs and similar purposes.

2.2 TEST INSTRUMENTS:

A. Utilize test instruments and equipment for the TAB work required, of the type, precision and capacity as recommended in AABC standards or NEBB Procedural Standards for Testing-Adjusting-Balancing of Environmental Systems.

PART 3 - EXECUTION

3.1 SCOPE:

A. Test, Adjust, and Balance the following:
1. Ductless Heat Pumps and Air Handlers
2. Energy Recovery Ventilators
3. Electric Heaters
4. Thru-Wall Heat Pumps
5. Make-up Air Units
6. Roof Air Conditioning Units
7. Roof Air Conditioning Units w/ Enthalpy Wheels
8. Fans
9. VRF Heat Pumps and Air Handlers
10. Air Inlets and Outlets

3.2 GENERAL REQUIREMENTS:

A. Perform total system balance in accordance with one of the following:
   1. *AABC, AABC National Standards for Total System Balance*.
   2. *NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems*.

B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work and submit Report prior to the Final Observation of the project.

C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.

D. Reports shall be certified by an AABC Certified Test and Balance Engineer or NEBB Certified Testing, Balancing, and Adjusting Supervisor experienced in performance of this Work.

3.3 EXAMINATION:

A. Review the contract documents for appurtenances and arrangement for balancing prior to the installation of any equipment or material. These shall include gauges, test plugs, valves, air volume balancing dampers, etc. The contractor shall be responsible for providing these in the locations recommended by the TAB agency in addition to any shown on the drawings or specified. Verify that duct layout design allows the TAB agency to perform duct pitot traverses to verify system air flows.

B. The Contractor shall notify the Architect of any omissions noted within 30 days of the Contractor's notice to proceed.

C. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
   1. Systems are started and operating in a safe and normal condition.
   2. Temperature control systems are installed complete and operable.
   3. Proper thermal overload protection is in place for electrical equipment.
   4. All filters are clean and in place. If required, install temporary media in addition to filters.
   5. Duct systems are clean of debris.
   6. Fans are rotating correctly.
   7. Fire and volume dampers are in place, accessible, operable, and open. Report observation on test report.
   8. All dampers and operators function smoothly from shut-off to full open.
   9. Air coil fins are cleaned and combed.
   10. Access doors are installed at specified components are accessible, are closed and duct end caps are in place.
   11. Air outlets are installed and connected.
   12. Duct system leakage is minimized.

D. Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.

3.4 INSTALLATION TOLERANCES:

A. Air Systems: Set HVAC system's air flow rates within the following tolerances:
   1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
   2. Air Outlets and Inlets: Plus or minus 10 percent.

B. Building Pressure: Ensure that installation tolerances result in each floor of the building being positively pressurized with respect to outside ambient pressure.

3.5 RECORDING AND ADJUSTING:

A. Field Logs: Maintain written logs including:
   1. Running logs of events and issues.
   2. Discrepancies, deficient or uncompleted work by others.
   3. Contract interpretation requests.
   4. Lists of completed task.

B. Ensure recorded data represents actual measured or observed conditions.

C. Permanently mark setting of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. Mark on the drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.

E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.6 FINAL TEST AND BALANCE REPORT:

A. The report shall be a complete record of the HVAC system performance in heating and cooling modes, including conditions of operation, items outstanding, and any deviations found during the TAB process. The final report also provides a reference of actual operating conditions for the owner and/or operations personnel. All measurements and test results that appear in the reports must be made on site and dated by the TAB technicians or test and balance engineers. Report shall contain test results, including instrumentation calibration reports, in the form recommended by the applicable standards.

B. The report must be organized by systems and shall include the following information as a minimum:
   1. Title Page:
      a. Certified company name
      b. Company address
      c. Company telephone number

d. Project identification number
e. Location
f. Project Architect
g. Project Engineer
h. Project Contractor
i. Project number
j. Date of report
k. AABC or NEBB Certification Statement
l. Name, signature, and certification number of AABC TBE or NEBB Qualified TAB Supervisor

2. Table of Contents

3. AABC National Performance Guaranty or NEBB Certificate of Conformance Certification

4. Report Summary:
   a. The summary shall include a list of items that do not meet design tolerances, with information that may be considered in resolving deficiencies.

5. Instrument List:
   a. Type
   b. Manufacturer
   c. Model
   d. Serial Number
   e. Calibration Date

6. Test and Balance Data:
   a. Provide test data for specific systems and equipment as required by the most recent edition of the "AABC National Standards" or “NEBB Procedural Standards for Testing Adjusting and Balancing of Environmental Systems”.

3.7 MINIMUM REQUIRED TEST DATA FOR SYSTEMS:

A. The following test data shall be submitted for each system type in addition to what is required by the "AABC National Standards" or “NEBB Procedural Standards for Testing Adjusting and Balancing of Environmental Systems”.

B. Ductless Heat Pumps and Air Handlers:
   1. Identification/ Number.
   2. Manufacturer model number and serial number.
   3. Design and actual supply airflow.
   4. Design and actual outside airflow.
   5. Cooling mode: design entering and leaving air DB/WB.
   6. Cooling mode: actual entering and leaving air DB/WB. (w/ concurrent OA temp)
   7. Heating mode: design entering and leaving air DB.
   8. Heating mode: actual entering and leaving air DB. (w/ concurrent OA temp)
   9. Verification that air treatment device is installed and operational.
   10. Record all notes pertinent to the test.

C. Energy Recovery Ventilators / Dedicated Outdoor Air System:
   1. Identification/ Number.
   2. Manufacturer model number and serial number.
   3. Design and actual supply fan airflow, RPM, voltage, amperage, ESP and Total SP.
   4. Supply fan sheave and belt data.
   5. Design and actual exhaust fan airflow, RPM, voltage, amperage, ESP and Total SP.
   6. Exhaust fan sheave and belt data.
   7. Cooling coil: design entering and leaving air DB/WB.
   8. Cooling coil: actual entering and leaving air DB/WB. (w/ concurrent OA temp)
   9. Heating coil: design entering and leaving air DB.
   10. Heating coil: actual entering and leaving air DB. (w/ concurrent OA temp)
   11. Enthalpy Wheel: design entering and leaving air DB/WB for OA entering, wheel leaving and exhaust entering air.
   12. Enthalpy Wheel: actual entering and leaving air DB/WB for OA entering, wheel leaving and exhaust entering air.
   13. Hot Gas reheat coil: design entering and leaving air DB/WB.
   14. Hot Gas reheat coil: actual entering and leaving air DB/WB. (w/ concurrent OA temp)
   15. Verification that air treatment device is installed and operational.
   16. Record all notes pertinent to the test.

D. Electric Heaters:
   1. Identification/ Number.
   2. Manufacturer model number and serial number.
   3. Design supply airflow.
   4. Heating coil: design entering and leaving air DB.
   5. Heating coil: actual entering and leaving air DB.
   6. Design and calculated KW.
   7. Record all notes pertinent to the test.

E. Make-up Air Units:
   1. Identification/ Number.
   2. Manufacturer model number and serial number.
   3. Design and actual supply airflows (Max and Min).
   4. Design and actual supply fan RPM, voltage, amperage, ESP and Total SP. (@ max airflow)
   5. Supply fan sheave and belt data.
   6. Heating coil: design entering and leaving air DB. (@ max airflow)
   7. Heating coil: actual entering and leaving air DB. (@ max airflow)
   8. Design and calculated KW.
   9. Record all notes pertinent to the test.

F. Roof Air Conditioning Units (Constant Volume):
   1. Identification/ Number.
   2. Manufacturer model number and serial number.
   3. Design and actual supply fan airflow, RPM, voltage, amperage, ESP and Total SP.
   4. Supply fan sheave and belt data.
   5. Design and actual outside airflow.
   6. Cooling coil: design entering and leaving air DB/WB.
   7. Cooling coil: actual entering and leaving air DB/WB. (w/ concurrent OA temp)
   8. Heating coil: design entering and leaving air DB.
   9. Heating coil: actual entering and leaving air DB.

10. Design and calculated heater KW.
11. Verification that air treatment device is installed and operational.
12. Record all notes pertinent to the test.

G. Roof Air Conditioning Units (Staged Air Volume):
1. Identification/ Number.
2. Manufacturer model number and serial number.
3. Design and actual Max supply fan airflow, RPM, voltage, amperage, ESP and Total SP.
4. Design and actual Min supply fan airflow.
5. Supply fan sheave and belt data.
6. Design and actual outside airflow. (@ max and min airflow)
7. Cooling coil: design entering and leaving air DB/WB.
8. Cooling coil: actual entering and leaving air DB/WB. (@ max airflow w/ concurrent OA temp)
9. Heating coil: design entering and leaving air DB.
10. Heating coil: actual entering and leaving air DB. (@ max airflow)
11. Design and calculated heater KW.
12. Hot Gas reheat coil: design entering and leaving air DB/WB.
13. Hot Gas reheat coil: actual entering and leaving air DB/WB. (w/ concurrent OA temp)
14. Verification that air treatment device is installed and operational.
15. Record all notes pertinent to the test.

H. Roof Air Conditioning Units w/ Enthalpy Wheels:
1. Identification/ Number.
2. Manufacturer model number and serial number.
3. Design and actual supply fan airflow, RPM, voltage, amperage, ESP and Total SP.
4. Supply fan sheave and belt data.
5. Design and actual exhaust fan airflow, RPM, voltage, amperage, ESP and Total SP.
6. Exhaust fan sheave and belt data.
7. Design and actual outside airflow.
8. Cooling coil: design entering and leaving air DB/WB.
9. Cooling coil: actual entering and leaving air DB/WB. (w/ concurrent OA temp)
10. Heating coil: design entering and leaving air DB.
11. Heating coil: actual entering and leaving air DB.
12. Design and calculated heater KW.
13. Enthalpy Wheel: design entering and leaving air DB/WB for OA entering, wheel leaving and exhaust entering air.
14. Enthalpy Wheel: actual entering and leaving air DB/WB for OA entering, wheel leaving and exhaust entering air.
15. Hot Gas reheat coil: design entering and leaving air DB/WB.
16. Hot Gas reheat coil: actual entering and leaving air DB/WB. (w/ concurrent OA temp)
17. Verification that air treatment device is installed and operational.
18. Record all notes pertinent to the test.

I. Fans:
1. Identification/ Number.
2. Manufacturer model number and serial number.
3. Design and actual fan airflow, RPM, voltage, amperage, ESP and Total SP.
4. Fan sheave and belt data.

J. VRF Heat Pumps and Air Handlers:

1. Identification/ Number.
2. Manufacturer model number and serial number.
3. Design and actual supply airflow.
4. Cooling mode: design entering and leaving air DB/WB.
5. Cooling mode: actual entering and leaving air DB/WB. (w/ concurrent OA temp)
6. Heating mode: design entering and leaving air DB.
7. Heating mode: actual entering and leaving air DB. (w/ concurrent OA temp)
8. Verification that air treatment device is installed and operational.
9. Record all notes pertinent to the test.

K. Air Distribution Tests:
1. Air terminal number.
2. Room number/ location.
3. Terminal type and size.
4. Design air flow.
5. Actual (final) air flow.
6. Percent of design air flow.
7. Relative position of balancing damper.

L. Duct Traverses:
1. System zone/ branch.
2. Duct size.
3. Area.
4. Design velocity and air flow.
5. Actual velocity and air flow.
6. Duct static pressure.
7. Air correction factor.

M. Space Temperature and Humidity:
1. Temperature and relative humidity (whether controlled or not) of each conditioned space.
2. Set point of each controlling thermostat or humidity sensing device.

3.8 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS:

A. Prepare test reports for both fans and outlets. Obtain approved submittals and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare single-line schematic diagram of systems for the purpose of identifying HVAC components.

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 condensate drains for proper connections and functioning.

G. Check for proper sealing of air-handling-unit components.

3.9 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 Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
      c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
      d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
   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 any artificial loading of filters at the time static pressures are measured.
   3. 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 will occur. 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 sub-main and branch duct volume dampers for specified airflow.

C. Re-measure each sub-main and branch duct after all have been adjusted.
   1. Adjust air inlets and outlets for each space to indicated airflows.
   2. Set airflow patterns of adjustable outlets for proper distribution without drafts.
   3. Measure airflow at all inlets and outlets.
   4. Adjust each inlet and outlet for specified airflow.

D. Re-measure each inlet and outlet after all have been adjusted.

E. Verify final system conditions.

F. Re-measure and confirm minimum outdoor air, return and relief airflows are within design. Readjust to design if necessary.

G. Re-measure and confirm total airflow is within design.

H. Re-measure all final fan operating data, rpms, volts, amps, static profile.

I. Mark all final settings.

J. Test system in economizer mode. Verify proper operation and adjust, if necessary.

K. Measure and record all operating data.

L. Record final fan-performance data.

3.10 AIR SYSTEM PROCEDURE:

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities.

B. Make air quantity measurements in ducts by Pitot tube traverse if entire cross-sectional area of duct. Close openings after measurement with permanent manufactured plugs.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers.

F. Vary total system air quantities by adjustment of fan speeds by drive sheave adjustment. Provide drive changes required to place belt in mid-position at final RPM. Vary branch air quantities by damper regulation.

G. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions. Adjust operators on outside air dampers to ensure tight seal when shut.

H. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

3.2 TESTING:

A. Tester must examine the installed work and conditions under which testing is to be done to ensure that work has been completed, cleaned and is operable. Notify the Contractor in writing of conditions detrimental to the proper completion of the test-adjusting-balancing work. Do not proceed with the TAB work until unsatisfactory conditions have been corrected in a manner acceptable to Tester.

B. Airflows shown on drawings are provided as a guide to achieve uniform room temperature throughout the building. Field correct as required to suite room condition. Any substantial alteration shall be called to the engineer's attention.

END OF SECTION 23 92 10

SECTION 26 01 00 - GENERAL PROVISIONS - ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 IMPOSED REGULATIONS:

A. Applicable provisions of the State and Local Codes and of the following codes and standards are hereby imposed on a general basis for electrical work:

1. NEC, National Electrical Code (NFPA No. 70), with Georgia Amendments.
2. The Life Safety Code (NFPA No. 101), with Georgia Amendments.
3. State of Georgia ADA Accessibility Guidelines for Building and Facilities.
4. The Standard Building Code, with Georgia Amendments.
5. The National Electrical Safety Code (ANSI C2.)
6. U.L. Fire Resistance Directory.
7. U.L. Electrical Construction Materials Directory.
8. U.L. Electrical Appliance and Utilization Equipment Directory.

1.3 SCOPE OF WORK:

A. Provide all labor, materials, equipment and supervision to construct complete and operable electrical systems as indicated on the drawings and specified herein. All materials and equipment used shall be new, undamaged and free from any defects.

1.4 COORDINATION:

A. Coordinate work provided under this division of the specifications with work provided under other divisions of the specifications and work provided by owner, where applicable.

1.5 PROJECT STAFFING:

A. Superintendent:

1. Provide a superintendent to plan, layout, supervise and coordinate the work provided by all organizations providing work under Division 26. The superintendent shall be at the job site at any time work is being performed.

2. The superintendent shall have a minimum of 5 years experience in educational projects of

similar size and scope. The superintendent shall have a State of Georgia unrestricted electrical contractor's license.

B. Organizations Furnishing and Installing Electrical Systems:

1. Traditional electrical systems work shall be furnished and installed by organizations who have successfully completed work of similar size and scope, and who have been in business for at least 3 years.
2. Electricians, 600V and below:
   a. Electricians assigned to the project shall have proof of having completed a formal training program which certifies that they are qualified to perform electrical work of the type encountered on this project and are familiar with the building codes which apply to this project. For the purposes of this project, workers not possessing these qualifications shall be considered helpers and shall not be allowed to perform electrical work.

C. Submit resumes for review and approval by the Architect prior to proceeding with any work on the project. Fill out Attachment 2, Section 260120 for each firm providing work under Division 26.

1.6 UTILITY CONNECTIONS:

A. The approximate point of origination for electric, telephone and television utilities is shown on the drawings. However, the contractor shall confirm the location with the respective utility prior to ordering materials or beginning any trenching. The Contractor's bid shall allow for the service point to be shifted by the utility, 25' feet in any direction from that shown.

1.7 PERMITS AND TEST; ELECTRICAL WORK:

A. Submit a record copy (for Owner's records) of electrical work notices, permits, licenses, inspection or test reports, and similar items obtained in response to governing and imposed codes, regulations and standards.

1.8 ELECTRICAL DRAWINGS:

A. Do not scale the electrical drawings. Obtain all dimensions from the Architect's dimensioned drawings, field measurements and shop drawings.

B. Electrical contract drawings are diagrammatic and indicate the general arrangement and connection of equipment and devices. Review product data sheets, wiring diagrams, manufacturer's installation instructions, etc. and provide the connections required to place equipment into service. Do not rely solely on the conductor counts shown on the drawings.

C. Discrepancies shown on different drawings, between drawings and specifications or between documents and field conditions shall be brought to the attention of the Architect. **The specifications do not override the drawings or vice-versa.**

1.9 EQUIPMENT REQUIRING ELECTRICAL SERVICE:

A. Provide connections for all electrically driven equipment, in accordance with the electrical drawings and the Division of the specifications in which the equipment is specified.

1. Connection shall include circuit breaker, wiring, control and disconnecting means (where applicable) and final connection.
2. Prior to ordering materials, review approved shop drawings of equipment that will be ordered and verify the connections shown. Fill out and submit the Coordination Affidavit required by Section 260120.
3. Where connection is required by other Divisions, but no connection is shown on the electrical drawings, provide connection to nearest panel of same voltage and phase based on the characteristics shown on other drawings. All added connections shall be brought to the attention of the Architect.
4. Provide 120 volt, 1 phase, 20 ampere power connection for all Division 23 control panels, whether indicated on the project drawings or not. Circuit from nearest 120/208 volt, 3 phase, 4 wire panelboard from available 20 amp, single-pole spares. Revise panelboard schedules accordingly. Document and coordinate control panel requirements and locations during preparation of the Coordination Affidavit, Attachment No. 1.

1.10 SYSTEMS REQUIRING ROUGH-IN:

A. Rough-in shall consist of all outlet boxes and covers/raceway systems/supports and sleeves required for the installation of cables/devices specified by other Divisions and by the Using Agency.

B. Review shop drawings to determine rough-in requirements; do not rely solely on the information shown on the drawings. Keep a copy of these shop drawings at the project site throughout the course of construction.

C. Systems requiring rough-in shall include, but not be limited to the following:

1. Mechanical equipment as shown in Divisions 22 and 23
2. Building equipment as shown
3. Equipment furnished by the Using Agency as shown on plans
4. Telephone service entrance
5. Television cable service entrance
6. Voice / data / video cabling systems.

D. Rough-in requirements are further defined in Section 261010. Prior to performing any rough-in, meet with the designated representative of the trade involved to confirm device locations, mounting heights, trim ring type and orientation. Additionally, the route of cable trays shall be adapted to suit the master cabling plan prepared under Division 27.

1.11 PERFORMANCE TESTING:

A. Testing specified in other sections shall be performed by authorized representatives of the

system manufacturer, scheduled and paid for by the Contractor.

1. The contractor shall provide personnel, tools and equipment necessary to conduct the tests.
2. Provide three copies of all test results. For each system, include a cover page with the Testing Agency letterhead, name of persons conducting the test, date(s) of tests, and an executive summary of the testing performed. Include the detailed results after this summary.

B. Notify the Architect, in writing, 48 hours in advance of any testing to be performed. Include the system, or systems to be tested. The purpose of this requirement is to allow the Architect and Using Agency time to schedule representatives to be present.

C. Schedule the work so that all tests can be conducted at one time.

D. Provide personnel and equipment necessary to make all work accessible to the testing agency.

E. A copy of the test reports will be made available to the owner. The contractor shall remove and replace all work that does not meet specified performance parameters. The contractor shall bear the expense of retesting systems.

1.12 RECORD DOCUMENTS:

A. The electrical superintendent shall maintain a white set (blue-line or black-line) of contract documents in clean, undamaged condition, for mark-up of actual installations which vary substantially from the work as shown. Mark-up whatever drawings are most capable of showing installed conditions accurately. These documents shall be used for no other purpose. As a minimum, record the following:

1. Post all addenda prior to beginning work.
2. Post all changes in the work.
3. Document actual feeder conduit routes, both interior and exterior. For lines run below grade or slab, dimension lines off of fixed surfaces.
4. Scope of each change order (C.O.), noting C.O. number.
5. Mark up all branch circuit connections.

1.13 RECORD MANUALS: (CLOSEOUT REQUIREMENTS)

Record manuals shall include the following:

A. Manufacturer’s operation and maintenance manuals for:

1. Lighting Fixtures
2. Lighting Contactors
3. Lighting Control System. Including Occupancy Sensors
4. Motor Starters
5. Panelboards and circuit breakers
6. Switchboards (Include manufacturer’s fabrication drawings)

7. Dry Type Transformers
8. Generator
9. Photovoltaic Equipment

B. Two sets of the manufacturer's fabrication drawings for each surface mounted raceway and each lab service outlet assembly. Fabrication drawings shall be keyed to the floor plans to denote the specific location in which the raceway was installed.

C. Shop drawings, revised to reflect all review comments, *supplemented with the installation instructions shipped with equipment.*

D. One copy of all panelboard directories plus CD/RW with electronic spreadsheets containing directories.

E. Exterior lighting control system wiring diagrams updated to reflect as-built conditions.

F. Lighting control system wiring diagrams updated to reflect as-built conditions.

G. All test results listed by specification section.

H. All required keys, tools, and spare parts.

Submit record manuals in quantities and in the format prescribed in the Division specifications, plus one copy for the Engineer.

1.14 TRAINING OF OWNERS FORCES:

A. Train Owner's personnel on the operation and maintenance of the following systems:

1. Tour of Facility - 8 hours
2. Exterior Lighting Control System - 2 hours.
3. Lighting Control System - 2 hours.
4. Generator System – 2 hours

B. The "tour of facility" shall consist of the walk-thru of at least one space of each type. The Division 26 Superintendent shall demonstrate operation of all lighting controls, emergency shut off controls, use of receptacles, etc. The tour shall be conducted jointly with Division 27.

C. Training shall not be conducted until system has been tested by the Contractor and is 100% operational. Training shall be conducted at the project site.

D. As a minimum, the following materials shall be reviewed during the training session:

1. Owner's operation and maintenance manual.
2. Corrected shop drawings and as-built system drawings.
3. Hands-on demonstration of system features and operation.

E. Schedule the training at least two weeks in advance. At that time, provide a detailed outline of the training session.

F. Training shall be conducted by authorized representatives of the system manufacturer and the Division 27 superintendent.

1.15 REVIEW OF THE WORK BY THE ARCHITECT:

A. During the course of the project, the work will be reviewed by a representative of the Architect. Upon each visit, the Contractor shall also demonstrate that the record documents and shop drawing files are being kept current. The Division 26 Superintendent shall accompany the Architect on all reviews and shall provide all personnel, tools, ladders, etc. necessary to conduct the review.

B. Prior to reviewing of work in progress, or at the final inspection, the Contractor shall submit a letter describing the specific work to be reviewed, along with a punch-list of items that are incomplete or which require correction, based on observations made by the supervisor of the given trade. Reviews will not be scheduled until this information is submitted. The Contractor shall bear the burden of any resulting delays.

C. Construction review reports will be issued by the Architect for every review trip. Within five working days from the date of review, the Contractor shall submit a letter which addresses when corrections will be made for each deficiency in the report. Prior to subsequent review of the work, the Contractor shall submit a letter confirming that the work required by all comments on the report has been completed.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Refer to the drawings and individual specification sections for requirements.

B. All equipment shall be suitable for the environment in which it is installed. Such considerations shall include, but not be limited to characteristics of this specific project such as wet/damp/dry locations, ambient temperature / humidity, spaces used as air plenums and hazardous locations. It shall be the responsibility of the contractor to review the contract documents and order equipment based on intended use.

2.2 MATERIALS:

A. All materials and equipment used shall be new, undamaged and free from any defects.

B. Provide materials and equipment that are U.L. listed, unless listing is unavailable.

C. All equipment of the same type or of the same product category shall be the product of a single manufacturer.

D. It is the responsibility of the Contractor to determine the shipping splits for large equipment.

E. Where product is specified by catalog number, such specification is intended only to convey general characteristics. Actual product selection shall be based on catalog number, other references on the drawings / specifications and intended use. Products not listed in these specifications or shown on drawings shall not be used.

2.3 ACCEPTABLE MANUFACTURERS:

A. Provide equipment and materials which are products of the manufacturers listed on the drawings and in the specifications. Requests for substitution of other manufacturers shall comply with Division 1 and the paragraph “B” below.

B. Requests for prior approval (i.e. before the bid opening) must contain all information listed for the specific item in Section 260120, including any applicable dimensioned layout drawings. Requests must be sent by mail or express delivery such that they are received in the Architect’s office no later than ten working days prior to the opening of bids. **Requests that are incomplete or are sent by facsimile will not be reviewed.**

PART 3 - EXECUTION

3.1 ROLE OF THE SUPERINTENDENT:

A. The Division 26 Superintendent’s duties shall include, but not be limited to the following:

1. Preparation of submittals.
2. Planning and layout of the work.
3. Coordination with other trades and the local utility company.
4. Posting addenda and changes in the work to maintain the Record Documents and to ensure that Division 26 personnel are working from up-to-date drawings and specifications.
5. Supervision of all Division 26 personnel.
6. Ongoing review of work in place to ensure compliance with the Contract Documents.
7. Administrative duties as required to fulfill the requirements of the General Conditions, Special Conditions and Division 1 specifications.
8. Training of the Owner’s personnel.

3.2 PROTECTION OF THE WORK:

A. Protect the work during the course of construction. Do not install any equipment or materials until the proper environmental conditions have been established.

B. Store materials in the manner recommended by the manufacturer until materials are installed. Materials rated for indoor use shall not be stored outdoors regardless of the packaging in which the materials are shipped.

C. Prior to the building being "dried-in", protect incomplete conduit runs, outlet boxes, equipment enclosures, etc. from the entry of water or construction debris, by installing and

maintaining temporary protective covers.

D. Do not install wiring devices, equipment or panel interiors until the building is dried-in. For the purposes of this specification “dried in” shall mean the roof has been installed, all exterior openings are covered and the interior of the building is dry.

E. Maintain temporary protective covers over equipment enclosures, outlet boxes and similar items after interiors, conductors, devices, etc. are installed, to prevent the entry of construction debris and to protect the installation during finish work performed by others. Do not install device plates, equipment covers or trims until finish work is complete.

F. Install temporary protective covers over equipment mounted on the building exterior to prevent corrosion damage during cleaning of the building exterior, by others.

G. Clean all equipment, inside and out, upon completion of the work. Scratched or marred surfaces shall be touched-up with touch-up paint furnished by the equipment manufacturer.

H. Equipment or materials that are improperly stored or are installed before the proper environmental conditions are achieved will be removed and replaced with new, at no cost to the Owner. The Contractor shall bear all consequences from any resulting delays.

I. All equipment and materials that become damaged will be removed and replaced with new, at no additional cost to the Owner.

3.3 CUTTING AND PATCHING:

A. Structural Limitations: Do not cut structural framing, walls, floors, decks, and other members intended to withstand stress, except with the Architect's written authorization. Authorization will be granted only when there is no other reasonable method for completing the electrical work, and where the proposed cutting clearly does not materially weaken the structure.

B. Cutting Concrete: Where authorized, cut openings through concrete (for conduit penetrations and similar services) by core drilling or sawing. Do not cut by hammer-driven chisel or drill.

C. Other Work: Do not endanger or damage other work through the procedures and process of cutting to accommodate electrical work. Review the proposed cutting with the Installer of the work to be cut, and comply with his recommendations to minimize damage. Where necessary, engage the original Installer or other specialists to execute the cutting in the recommended manner.

D. Patching: Where patching is required to restore other work, because of cutting or other damage inflicted during the installation of electrical work, execute the patching in the manner recommended by the original Installer. Restore the other work in every respect, including the elimination of visual defects in exposed finished, as judged by the Architect. Engage the original Installer to complete patching of various categories of work including: concrete and masonry finishing, waterproofing and roofing, exposed wall finishes, etc.

3.4 INTERFACE OF ELECTRICAL WORK WITH OTHER TRADES:

A. Where electrical work must connect to or be incorporated into work installed by other trades, engage the services of the other trade to interface the work. Under no circumstances shall the installer performing work under this Division of the specifications modify or alter work installed by others. Such work includes, but is not limited to:

1. Roof Penetrations.
2. Any attachments to roofing system.
3. Penetrations in Vapor Barriers.
4. Exterior Insulation and Finish Systems (EIFS).

END OF SECTION 26 01 00

SECTION 26 01 20 - ELECTRICAL SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 GENERAL:

A. Submit for review by the Architect a schedule with engineering data of materials and equipment to be incorporated in the work.

1. Submittals shall be supported by descriptive materials, i.e., catalog sheets, product data sheets, diagrams, performance curves and charts published by the manufacturer, to show conformance to Specifications and Plan requirements; model numbers alone shall not be acceptable.
2. Data submitted for review shall contain all information to indicate compliance with Contract Documents. Complete electrical characteristics shall be provided for all equipment.
3. Submittals for lighting fixtures shall include Photometric Data.
4. The Architect reserves the rights to require samples of any equipment to be submitted for review.

B. Prepare submittals, including the necessary inter-division planning and coordination in accordance with the approved project schedule. Note that certain Division 26 submittals cannot be prepared until approved submittals are available from other Divisions of the work.

C. Submittal material shall be assembled and checked by the Division 26 superintendent.

D. All layout drawings shall be prepared under the supervision of, and checked by the Division 26 superintendent.

E. The fault current calculation required by Section 262043-Switchboards shall be provided after service has been installed and inspected by the Authority Having Jurisdiction.

1.3 RESPONSE TO SUBMITTALS:

A. Shop drawings shall be evaluated by the Architect in accordance with the following classifications:

1. "No Exceptions Taken": No corrections, no marks. Items may be ordered.
2. "Make Corrections Noted": A few minor corrections. Items may be ordered as marked up without further resubmission.

3. "Revise and Resubmit": Minor correction. Item may be ordered at the Contractor's option. Contractor shall resubmit drawings with corrections noted.
4. "Rejected": Major corrections or not in accordance with the contract documents. No items shall be ordered. Contractor shall correct and resubmit drawings.

B. Whether resubmittals are required or not, all shop drawings shall be corrected for the record manuals specified in Section 260100.

1.4 FORMAT:

A. Submittals shall be made by specification section. Submittal data shall be placed in one or more hard-back 3-ring binders arranged and labeled according to specification section.

1. Each binder shall contain a title page and table of contents. Provide separator tabs, and label by specification section. Make note in the table of contents, any drawings that accompany the submittal.
2. Title page shall contain Project Name, Contractor’s Name, Division 26 Superintendent’s name, Suppliers and point of contact for each, and date.

1.5 SUBMITTAL GROUPING:

A. Submittals shall be made in no more than two groups.

B. All submittals for a given system shall be submitted at the same time. For example, wiring diagrams and other detailed layout information must be submitted with equipment data sheets.

C. Submittals that do not comply with these requirements or that are deemed by the Architect to be incorrect shall be returned without review. The Contractor shall bear the burden of any resulting delays.

1.6 EQUIPMENT AND MATERIALS REQUIRING SUBMITTALS:

A. Section 260100 - General Provisions

1. Superintendent’s resume
2. Electricians’ qualifications

B. Section 260120 - Electrical Submittals

1. Equipment Layout Drawings
2. Attachment 1

C. Section 261010 - Raceway Systems

1. Raceways and Fittings
2. Expansion Fittings

3. Wall Boxes and Covers
4. Ceiling Boxes and Covers
5. Floor Boxes and plates
6. Pull Boxes
7. Troughs
8. Firestopping Materials and Installation Drawings
9. Corrosion Protection

D. Section 261020 - Cable Trays for Low Voltage Systems

1. Cable Trays
2. Connectors
3. Bracing
4. Accessories

E. Section 262010 - Wires and Cables

1. Conductors
2. Connectors
3. Splices

F. Section 262020 - Wiring Devices

1. Receptacles
2. Switches
3. Dimmers
4. Occupancy/Vacancy Sensors & switches
5. Occupancy/Vacancy Sensor layout drawings
6. Weatherproof Covers
7. Device Plates

G. Section 262021 - Safety and Disconnect Switches

1. Safety Switches
2. Motor Rated Switches
3. Equipment List
4. Arc Flash Warning Labels
5. Nameplates

H. Section 262030 - Lighting Fixtures

1. Lighting Fixtures
2. Emergency Drivers

I. Section 262040 - Motor Starters

1. Starters
2. Overload element ratings
3. Control power transformers / ratings
4. Pilot Lights

5. Control Devices
6. Phase Failure Relays
7. Equipment List
8. Arc Flash Warning Labels
9. Nameplates

J. Section 262042 - Panelboards

1. Enclosures
2. Dimensional Data
3. Locks
4. Directory
5. Circuit Breakers
6. Bussing Diagrams
7. Arc Flash Warning Labels
8. Nameplates

K. Section 262043 - Switchboards

1. Enclosures
2. Dimensional Data
3. Circuit Breakers
4. Layout Drawing
5. Metering
6. Arc Flash Warning Labels
7. Nameplates

L. Section 262044 - Separately Enclosed Circuit Breakers

1. Circuit Breakers
2. Enclosures
3. Dimensional Data
4. Control Wiring Diagrams
5. Arc Flash Warning Labels
6. Nameplates

M. Section 262047 - Dry Type Transformers, 600V and Below

1. Enclosures
2. Dimensional Data
3. % Impedance
4. Temperature Rating
5. Winding Material
6. Taps
7. Sound Ratings
8. Efficiency Ratings at 25%, 50%, 75% and 100% load.
9. Wiring Diagram (including grounding and bonding)
10. Suspension components
11. Arc Flash Warning Labels
12. Nameplates

N. Section 262049 - Surge Suppression / EHF Filter System

1. Data sheets
2. Dimensions for each suppressor type indicating mounting arrangement and required accessory hardware. Statement that maximum lead length required to connect suppressor will not increase clamping voltages from published values.
3. Manufacturer's letter certifying compliance with listed guidelines and standards.

O. Section 262080 - Electrical Grounding, 600V and Below

1. Ground Rods
2. Conductors
3. Connectors
4. Bonding Bushings
5. Ground Rod Enclosures

P. Section 264000 – Seismic Control for Electrical Equipment

1. Seismic anchorage requirements and calculations (with Registered Engineer's stamp.)
2. Seismic control devices.

Q. Section 26 5000 - Lightning Protection System

1. Lightning Protection System Components
2. Layout drawing including all bonding of metal bodies
3. Installation Details
4. Letter from Roofing Contractor / Roof Supports and Penetrations
5. Installer Qualifications
6. Certification that system complies with U.L. Master Label requirements

R. Section 26 6011 - Emergency Power Systems

1. Certification of site for service / warranty
2. Compliance / Labels (including EPA emissions compliance letter)
3. Maintenance Agreement
4. Rating
5. Engine
6. Generator
7. Controller
8. Instrument Panel
9. Mounting Base
10. Accessories
11. Automatic Transfer Switch
12. Automatic Transfer Switch Arc Flash Warning Label
13. Automatic Transfer Switch Nameplate

S. Section 26 7010 – Photovoltaic Systems

1. Installers Certifications

2. Photovoltaic Modules
3. Inverters
4. Combiner Boxes
5. DC Disconnects
6. Installation Drawings
7. Roof Layout Drawings
8. Array tilt angles and azimuth angles
9. Elevation Details
10. PV Roof Structure Supports
11. Calculations detailing produced wattage, voltage, and current of proposed system.
12. Warranty

PART 2 - PRODUCTS

2.1 NOT APPLICABLE:

PART 3 - EXECUTION

3.1 MANUFACTURER'S DATA:

A. Include the manufacturer's comprehensive product data sheet and installation instructions.

B. Where operating ranges are shown, mark data to show portion of range required for project application.

C. Where pre-printed data sheet covers more than one distinct product-size, type, material, trim, accessory group or other variations, delete or mark-out portions of the pre-printed data which are not applicable.

3.2 EQUIPMENT LIST:

A. Where more than one type of a product is being used (i.e. starters, disconnects, breakers, etc.) provide a list with each submittal correlating the type and size of product to the load served.

3.3 TEST REPORTS:

A. Submit test reports which have been signed and dated by the firm performing the tests, and prepare in the manner specified in the standard or regulation governing the tests procedure as indicated.

3.4 ELECTRICAL LAYOUT AND COORDINATION DRAWINGS:

A. Electrical Rooms: Provide layouts of all electrical rooms, using the dimensions of equipment actually furnished. Locate all ducts and piping entering or crossing these spaces.

B. Mechanical Rooms and Mechanical Equipment Yards: Provide layouts showing all mechanical equipment based on dimensions of the actual equipment provided. Show the location of all motor controls, disconnect switches, control power junction boxes and conduit stub-ups at equipment. Location of stub-ups shall be based on manufacturer's installation drawings.

C. Panel and Equipment Feeders, 60A or more: The routing of feeders is not shown on the drawings. Actual routing shall be determined by the contractor in accordance with the specifications and shall be coordinated with work by other trades. For feeders of 60A or higher rating, provide layout drawings showing proposed routes.

D. Provide dimensioned layout drawings for all pendant mounted lighting fixtures as specified in Section 262030.

E. Provide dimensioned installation drawing for each busway system. All components shall be identified.

F. Lightning protection system layout drawings, as specified in Section 265000.

G. System specific drawings - Include the following:

1. Floor plans:
   a. Show all system equipment, devices and interconnecting cabling. Provide a legend to define all devices and cable runs.
2. Details:
   a. Show the rough-in requirements and mounting height for every component Include all requirements such as outlet box size/trim/alignment and raceway requirements.
   b. Prepare in sufficient detail such that these drawings can be used to provide the required rough-in.
3. Point-to-point installation wiring diagrams of the entire system:
   a. Provide terminal diagram for every control panel.
   b. Provide wiring diagram for every device. Key these diagrams to the system diagrams.
   c. Provide wiring diagram depicting all interlocks of specific systems with other systems.
   d. Spare and unused terminals shall be marked as such. Indicate the size, type and color code of all conductors.
   e. The use of generic wiring diagrams is not acceptable. Wiring diagrams shall be prepared for this specific project.
4. Elevations:
   a. Provide an elevation drawing of the headend equipment / control panel / backboard, showing the location of all components.
   b. Indicate enclosure sizes and space available for future expansion.

H. Drawing Format:

1. Drawings shall be prepared at the following scales:
   a. Floor plans: 1/8" = 1'-0".

b. Electrical Rooms: 1/4" = 1'-0".
c. Mechanical Rooms / Equipment Yards: 1/4" = 1'-0".
d. Feeder routes: 1/16 " = 1'-0".
e. Duct Bank Profile Drawings: See Section 261011.
f. Layout drawings for pendant mounted lighting fixtures: 1/2" = 1'-0".
g. Lightning protection system layout drawings: 1/16 " = 1' - 0".

2. The scales defined above are for plan views. Device assembly drawings, wiring diagrams, etc. may be prepared “not to scale”.

3. Drawings shall be titled to define Project Name, Drawing subject, date prepared and designer’s name and seal. All revisions shall be marked and dated.

4. Drawings shall include all room names and numbers.

5. CAD-generated drawings are required. Upon written request, an .zip file containing the building floor plan(s) can be furnished to the contractor at a nominal cost, in Autocad 2012 format. By requesting these drawings, the contractor agrees to accept them “as is”. It will be the responsibility of the contractor to verify the drawings for accuracy and to make all changes necessary, at no additional cost to the Owner.

6. Submit only one copy of each drawing, in reproducible format. The Architect will mark review comments on the reproducible drawing so that the contractor can make as many copies as may be required.

3.5 ATTACHMENT NO. 1:

A. The intent of Attachment Number 1 is to insure that the electrical requirements for equipment have been reviewed and coordinated by the Contractor. No electrical equipment shall be ordered, nor shall rough-in begin, before this coordination has taken place. This document shall be returned appropriately marked whether or not any changes are deemed to be necessary by the contractor.

ATTACHMENT NO. 1

SHOP DRAWING COORDINATION AFFIDAVIT

I, the Division 26 Superintendent, certify that I have reviewed the equipment shop drawings for electrically driven equipment and that the accompanying electrical shop drawings reflect the requirements of the actual equipment to be furnished for use on this project. The following deviations from design drawings were required to serve the furnished equipment:

ITEM	CKT. DESIG.	BKR.SIZE		CONDUIT/WIRE		DISC.SIZE		STARTER	
		New	Old	New	Old	New	Old	New	Old

NOTE: If no deviations are required please indicate by circling the appropriate answer above your signature.

PROJECT: _____ DEVIATIONS: Yes / No

COMPANY:_____

TITLE: _____ SIGNATURE: _____

TELEPHONE: _____DATE:_____

FAILURE TO PERFORM THE WORK REQUIRED BY THIS AFFIDAVIT, PRIOR TO ORDERING MATERIALS OR ROUGHING-IN, MAY RESULT IN IMPROPER CONNECTIONS BEING PROVIDED. THE EXPENSE OF CORRECTIVE MEASURES, IF REQUIRED, SHALL BE BORNE BY THE CONTRACTOR.

END OF SECTION 26 01 20

SECTION 26 10 10 - RACEWAY SYSTEMS AND SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SCOPE OF WORK:

A. The requirements of this section apply to all electrical raceway systems and supporting devices, installed under this contract, except for concrete encased duct banks. Electrical raceway system is defined to include, but not be limited to, all electrical raceways, boxes, fittings and similar components necessary for a continuous pathway for the installation of cables or conductors. Supports are any devices or components used to support raceways or electrical equipment.

B. Concrete encased duct banks are specified under Section 261011.

C. Cable Trays for low voltage systems are specified in Section 261020.

1.3 QUALITY ASSURANCE:

A. Submittals: Refer to Section 260120 for requirements.

PART 2 - PRODUCTS

2.1 ELECTRICAL METALLIC TUBING (EMT):

A. Uses permitted:

1. Indoors concealed in walls or ceiling.
2. Concealed in slabs above grade.
3. Exposed horizontal runs installed at least 7' above finished floor.

2.2 INTERMEDIATE METAL CONDUIT (IMC) OR RIGID GALVANIZED STEEL CONDUIT (RGS):

A. Uses permitted:

1. Indoors concealed or exposed.

2. Transition from below grade nonmetallic raceway system to above grade metallic raceway system.
3. Refrigerated spaces.
4. Vertical drops serving equipment.

2.3 RIGID NON-METALLIC CONDUIT (SCHEDULE 40 PVC):

A. Uses permitted:

1. Below grade installations.
2. Grounding electrode conductor raceway.
3. Lightning protection system down conductor raceway.

2.4 FLEXIBLE METAL CONDUIT:

A. Uses permitted:

1. Final connection to lighting fixtures.
2. Final connection to other than Division 23 equipment located in indoor, dry locations.

2.5 LIQUID-TIGHT FLEXIBLE METAL CONDUIT:

B. Uses permitted:

1. Final connection to equipment in indoor or outdoor locations.

2.6 CABLE RUNWAY:

A. Installed where shown to support cables specified under Division 27, limited to use at backboards and above equipment cabinets. This product is not the same as the Cable Trays specified in Section 261020.

B. Material: ASTM A36 steel bar:

1. Stringers: 3/8" x 2"
2. Rungs: ½" x 1" steel channel welded, @ 9" on centers
3. Runway width: 12"

C. Finish: Baked polyester powder coat, telephone gray.

D. Provide hanger kits, corner kits and other accessory fittings needed to install in the configurations specified.

E. Cable runways and accessories shall be the product of B-Line, Kindorf or Cope.

2.7 INNERDUCTS:

A. Innerducts shall be used where specifically indicated.

B. Innerducts shall be solid wall (ribbed) suitable for the use intended.

C. Provide metered tape and pull cord in all innerducts.

D. When installed within conduits, terminate conduit runs with non-metallic, corrosion-proof, water/air/gas tight triplex or quadruplex duct plugs, for the number of innerducts installed. Additionally, provide duct plugs of the same type in all runs in which conductors are not installed.

2.8 SLEEVES:

A. Conduit sleeves shall be RGS unless otherwise required by the through penetration firestop system selected.

B. Sleeves shall be minimum 1" and maximum 4" diameter, provided in quantities necessary to install cable systems specified in Divisions 23 and 27.

C. The contractor shall take special note that sleeve fill will be limited by the specific through penetration firestop system used. ***In no case shall the fill exceed 40%***.

2.9 CONNECTORS/COUPLINGS:

A. Connectors/couplings for use with EMT conduit shall be steel compression type, except that steel, set screw type will be acceptable for EMT conduits sizes 2-1/2" and larger.

B. Connectors/couplings for use with IMC and RGS conduit shall be threaded type.

C. All connectors shall be insulated throat type.

D. Locknuts shall be of the same material as connectors.

E. All fittings shall be raintight. Fittings encased in concrete shall be concrete-tight.

2.10 CONDUIT BODIES:

A. Provide galvanized steel or cast metal conduit bodies constructed with threaded conduit ends, removable cover, and corrosion resistant screws.

2.11 CEILING OUTLET BOXES:

A. Provide 4" octagon, galvanized steel interior outlet boxes constructed with stamped

knockouts in back and sides and with threaded holes with screws for securing box covers or wiring devices.

2.12 WALL OUTLET BOXES:

A. Recessed:

1. Boxes shall be galvanized steel constructed with stamped knockouts in back and sides and with threaded holes with screws for securing box covers or wiring devices.
2. Minimum box size shall be 4" square by 1-1/2" deep.
3. Boxes for GFCI outlets, Division 22, Division 23, and Division 27 devices and other locations deemed necessary, shall be 4-11/16" square by 2 1/8" deep.
4. Boxes shall have square edge tile type covers.
5. Where devices are ganged, use gang-type boxes with gang box covers.
6. The use of gangable type outlet or switchboxes is not acceptable unless required by specific device manufacturer.
7. Use masonry type boxes of equal or greater volume to those specified above, in masonry walls.

B. Surface:

1. Use cast aluminum box with threaded hubs in conjunction with metallic conduit systems.

C. Special Conditions:

1. Where box type specified herein conflicts with requirements of equipment to be installed, equipment manufacturer’s requirements shall govern.

2.13 FLOOR BOXES:

A. Recessed:

1. Recessed floor boxes shall comply with the details on the drawings and these specifications. Nominal dimensions shall be 10" x 12" x 6" deep.
2. Boxes shall be suitable for use in poured concrete as illustrated on the drawings.
3. Interiors shall be compartmentalized, using metal barriers, to separate line and low voltage wiring. Barriers shall be configured to accept the number and type of devices shown on the drawings.
4. Boxes shall be provided with both a temporary and finished covers, nominal 10.5" x 12.5". Temporary cover shall be 11 gauge cold-rolled steel. Finished cover shall be 1/8" thick cold-rolled steel with 6-1/2" x 8" hinged cover and nominal 3" x 3" hinged cable access door, both with 1/4" high aluminum edging.
5. Floor boxes shall have three duplex receptacles and mounting provisions for Division 27 telecommunications jacks as indicated on the drawings.
6. Provide blank metallic covers for all unused openings.
7. Provide hubs suitable for the wiring installed.

2.14 INTERIOR PULL BOXES:

A. Provide galvanized sheet steel boxes without knockouts. Provide surface boxes with screw-held covers in unfinished areas. In finished areas, including storage rooms, provide recessed boxes with screw-held cover, finished to match panelboards.

2.15 WIRING TROUGHS:

A. Troughs shall be made of code gauge galvanized steel, without knock-outs, and shall be suitable for surface mounting. Provide screw-held, removable front cover. Trough and cover shall be finished the same as panelboards. Dimensions shall be as indicated on the drawings. Provide knock-outs as required.

2.16 SUPPORTS:

A. Supporting devices shall be the products of manufacturers' specifically intended for supporting electrical raceways, devices and equipment. Makeshift supports are not acceptable. Where channel type supports are used, select complete assemblies such as those illustrated in the B-Line Strut Systems Engineering Catalog, based on the weight of the raceway(s) or equipment being supported.

B. The use of tie wire or tie wraps as a means of support for electrical raceways, devices and equipment is not permitted.

C. Plywood backboards shown in Communications Rooms or otherwise for the support of low-voltage cabling systems and/or mounting of equipment shall be fire resistant, Type AC rated. The plywood shall be painted with gray, fire resistant coating. Ensure that the plywood rating seal is left exposed after painting.

2.17 FIRESTOPPING:

A. A through-penetration firestop system shall be used to seal penetrations of electrical conduits and cables through fire-rated partitions per NEC 300-21 and NEC 800-3. The firestop system shall be qualified by formal performance testing in accordance with ASTM E-814, or UL 1479.

B. The firestop system shall consist of a fire-rated caulk type substance and a high temperature fiber insulation. It shall be permanently flexible, water-proof, non-toxic, smoke and gas tight and have a high adhesion to all solids so damming is not required. Only metal conduit shall be used in conjunction with this system to penetrate fire rated partitions. Install in strict compliance with manufacturer's recommendations. 3M, Metacaulk or Nelson.

C. **Submit installation drawings for conduit penetration, cable in metal sleeve penetration and blank metal sleeve penetration for each type of wall/floor construction encountered.**

D. Schedule a representative of the manufacturer to conduct a product demonstration / training session for each through-penetration firestop system to be used on this project. The session

shall be held at the project site.

PART 3 - EXECUTION

3.1 RACEWAY INSTALLATION - GENERAL:

A. Wherever possible, install horizontal raceway runs above water and drain piping. Give the right-of-way in confined spaces to piping which must slope for drainage and to larger HVAC duct work and similar services which are less conformable than electrical services. *However, ensure that all junction boxes and other points of access in raceway systems are located such that they are not rendered inaccessible.*

B. Complete the installation of electrical raceways before starting installation of cables within raceways.

C. All above grade conduits shall be routed parallel or perpendicular to the building structure.

D. **Raceways shall not be installed exposed in finished spaces or on the exterior of the building.** Install concealed in walls, ceilings, below slab-on-grade or embedded in slabs above grade. *Where raceway system serves surface mounted* equipment (i.e. safety switch), mount equipment over recessed outlet box.

E. All exposed raceway systems shall be painted to match the surface to which it is attached. All components of the raceway system shall be painted, i.e. conduits, boxes, supports, etc. Painting is specified under other divisions of the work.

F. Provide 200 lb. nylon pull cord in all conduits installed for cable systems specified under Division 23 and Division 27; and where conduits will be left empty for future use. Cap open ends and mark location of opposite end with black indelible marker pen.

G. Seal the inside of all conduits entering the building from outside, whether they connect to enclosures or not.

H. Do not run raceways atop the roof deck, through stairwells or elevator shafts.

3.2 BELOW SLAB AND IN-SLAB INSTALLATIONS: (within the building footprint)

A. *Do not install conduits in slabs on-grade.* Raceways shall be routed under the first floor building slab. Conduits shall be routed such that the top of the conduit is a minimum of six inches below the slab.

B. All 90 degree elbows and all stub-ups through the floor slab for all size conduits shall be corrosion protected RGS or corrosion protected IMC.

C. Raceways in slabs above grade shall be totally embedded in the slab. They shall be placed above the lower reinforcing and below the upper reinforcing. The outer edge in no case shall be less than 1" from the surface of the slab. The corners of raceways at turnups into walls

shall not be exposed at the wall/floor junction.

D. Raceways for Division 27 systems shall not be installed in or below slabs unless specifically indicated.

3.3 BELOW GRADE INSTALLATIONS: (outside the building footprint)

A. Perform all excavating, trenching and backfilling to install work of this project in accordance with applicable sections of Division 2 of the specifications and ANSI C2. Bottom of trenches shall be smooth and level to provide uniform bearing for conduits.

B. Secure conduits in trench to eliminate unnecessary curvature and to prevent movement of conduits while backfilling.

C. Maintain 6" vertical separation between conduits installed one above the other. Backfill and compact each layer separately. The minimum cover requirements specified herein shall be referenced to the uppermost layer of conduits.

D. Maintain minimum 12" horizontal and 6" vertical separation between conduits of different systems and between other underground utilities.

E. Backfill shall be free of rocks, sticks, roots, trash or other debris which may injure conduits or diminish compaction.

F. Minimum cover requirements:

1. Exterior lighting branch circuits: 18".
2. Telephone / TV service conduits: 24".
3. Service entrance and feeder conduits, 600V and below: 30".

3.4 GRADE LEVEL PULL BOXES:

A. Top of boxes shall be set flush with finished grade and shall be aligned parallel or perpendicular to predominant site features (i.e. sidewalks, etc.)

B. The exact location of boxes shall be field determined based on existing conditions and coordination with other underground utilities.

C. Conduits shall enter boxes through field-made openings in the sides of box. Conduits shall not enter the bottom of box. Make and seal all openings in accordance with the box manufacturer’s recommendations.

D. Provide a 6" layer of crushed rocks beneath open-bottom type boxes.

3.5 MOISTURE PROTECTION:

A. Conduits entering refrigerated spaces - Provide sealing fitting at accessible location outside

the refrigerated space. Seal raceway to prevent the entry of moisture.

B. Where conduits pass from a conditioned space to a non-conditioned space, apply insulating electrical putty inside conduit, at an accessible location, to prevent the entry of moisture.

C. Conduits and boxes installed in exterior walls shall not penetrate the vapor barrier.

D. Boxes installed on the building exterior shall have gasketed covers. All conduits entering box shall be sealed with insulating electrical putty.

3.6 CORROSION PROTECTION:

A. Corrosion protection for conduits passing through concrete slabs shall be by one of the following means:

1. Field-wrap conduits with tape, using with a 50 percent overlay. Tape shall be premium 7-mil, flame retardant, weather resistant tape. Resists temperature and moisture for splicing. Meets requirements of UL 510, HHI-595, and CSA 22.2.
2. Conduits shall have a factory-applied polyvinyl chloride, plastic resin, or epoxy coating.

B. All supporting materials installed exposed on the building exterior shall be hot-dipped galvanized after fabrication or provide an equivalent level of corrosion protection. Protect exterior raceway systems from damage while the building exterior is cleaned. Replace any portions of the system showing signs of rust at the time of final inspection.

3.7 GROUNDING:

A. Metallic raceway systems shall be made electrically continuous to provide a low impedance path to ground for faults, as required by the NEC.

3.8 RACEWAY BENDS:

A. Bend radius shall comply with the NEC and the requirements of the specific cabling system installed. For television and telephone service entrance conduits, consult with the local utility.

B. All field bends shall be made with a tool specifically intended for the purpose.

C. Tools using open flames are not acceptable for bending PVC conduit. Any section of conduit discolored or deformed in any way shall be cut out and replaced.

3.9 FLEXIBLE CONNECTIONS:

A. Final connections to light fixtures may be made using 3/8" diameter flexible metal conduit not exceeding 6 feet in length.

B. ½" diameter flexible metallic conduit may be used to fish existing walls, within the limits of

NFPA 70.

C. Final connections to motors and to other electrical equipment subject to movement and vibration shall be made using Liquid-tight flexible metal conduit not more than 24" long.

3.10 SLEEVES:

A. Provide sleeves of the size and quantity required to install cabling systems specified under Division 23 and Division 27. Where multiple sleeves are required, install in a rectangular array.

B. Make and seal all penetrations to maintain fire rating of member penetrated. Pay particular attention to the annular space required around the inside and outside of the penetrating item. Sealing compounds shall be re-enterable type.

C. Coordinate the exact placement of sleeves with other trades to ensure they are readily accessible and are not obstructed by pipes, ductwork, etc.

D. Sleeves shall be flush with both sides of the member penetrated unless otherwise required by the through penetration firestop system selected.

3.11 RACEWAY LAYOUT:

A. Unless noted otherwise, the layout of all raceway systems is the responsibility of the Contractor.

B. Provide pull points as required by the NEC and ensure that all such points are readily accessible and not blocked by ducts, pipes, etc.

3.12 WALL OUTLET LAYOUT:

A. The location of devices shown on the drawings is schematic. Prior to roughing-in, review the Architectural interior elevations and millwork shop drawings, to ensure that outlets will not be installed behind cabinets or otherwise inaccessible. Ensure that there is sufficient space from door jamb, cabinets, etc. to install without trimming device cover.

B. Outlets installed below countertops shall be centered in the kneespace.

C. All outlets shall be installed vertically except where space above counter back splash and other features does not permit, and when installed in baseboards. In such cases, outlets shall be installed horizontally.

D. Maintain uniform spacing of outlets shown to be side-by-side on the plans. Spacing shall not exceed 2" in framed walls. For masonry walls, install outlets in adjacent cells.

E. Gang mount switches shown in the same location, unless noted otherwise. Provide metal barrier in boxes between switches, when switches are connected to opposite phases of

systems exceeding 150V to ground.

F. Mark the branch circuit identification on the cover of all outlet boxes.

G. Provide separate outlet boxes and flexible final connections for fixtures provided with both normal and emergency power connections.

3.13 SUPPORTS:

A. Raceways:

1. Support all components of the electrical raceway system using wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; by machine screws, welded threaded studs, or spring-tension clamps on steel work.
2. Support individual raceways with conduit straps or clips. Support multiple runs using trapeze-type hangers. Trapeze hangers shall consist of 1-1/2" x 1-1/2" gage steel channels, 1/2" diameter threaded steel rods and conduit clamps. Attach rods to the building structure or to 1-1/2" x 1-1/2" gage steel channels span between adjacent structural members.
3. Support conduits at distances required by the National Electrical Code. *Additional supports shall be provided at the points of tangency of all bends.*
4. Joints in conduit systems shall coincide with point of support.
5. Provide expansion joints in all raceway systems in either of the following conditions:
   a. In accordance with manufacturer's literature, based on length of run and temperature differential that will be encountered.
   b. When raceways cross expansion joints.

B. Outlet Boxes:

1. Ceiling outlet boxes shall be supported by lightweight channel attached to structure with (2)-1/4" threaded rods and braced to prevent lateral movement.
2. Masonry walls:
   a. Install outlet boxes in sawcut openings.
   b. Outlet boxes shall be grouted in place, back and sides. There shall no reveals around the perimeter of the box.
3. Framed walls:
   a. Non-rated walls - Outlet boxes shall be attached to intermediate horizontal supports between vertical framing members. *Do not attach boxes to vertical members*.
   b. Framed walls rated 1-hr or 2-hr, boxes 16 square inches or less - Compartmentalize each outlet box (top, bottom and sides) using same material as wall framing. All penetrations in framing members shall be sealed. Where penetrations exceed 100 square inches per 100 square feet of wall space, install in accordance with subparagraph "c" below.
   c. Framed walls rated 1-hr or 2-hr, boxes exceeding 16 square inches - Compartmentalize boxes as specified above. Additionally, Boxes shall be covered back, top, bottom and all sides with drywall such that the rating is carried around the box. All penetrations in this envelope shall be sealed.
4. Boxes shall not be installed in walls rated more than 2-hr.

5. Do not install outlets back-to-back. Maintain 24" offset in rated walls and with no overlap in non-rated walls. Where groups of outlets are shown back-to-back, each group of outlets shall be shifted to accommodate the installation. *Exceptions: (1- Outlet boxes in non-rated masonry walls, may be installed back-to-back. Do not break webbing or connect boxes back-to-back. The use of thru-wall outlet boxes is not permitted. 2- The 24" offset may be eliminated in 1-hr and 2-hr walls when U.L. listed moldable putty is installed around box, in accordance with the U.L. Fire Resistance Directory.*)
6. Outlet boxes mounted in STC rated walls shall be sealed in accordance with Gypsum Association Document GA-600 “Fire Resistance Design Manual, Sound Control”.
7. Cover of outlets installed flush mounted in walls shall be set back no more than 1/8" from face of wall.

3.14 FLOOR BOXES:

A. General:

1. Floor box locations shall be by FSR or equal based on the dimensions shown on the drawings, subject to field co-ordination with building structural elements. Any necessary adjustments in location shall be approved by the Architect. The location process is critical to ensure that placement of box does not interfere with furniture or user.
2. Floor boxes and raceway system shall be thoroughly cleaned and dried before installing devices and wiring. Seal the inside of all raceways entering floor box with clear, re-enterable, water-proofing compound after conductors and cables have been installed.

B. Recessed:

1. Floor boxes shall be covered by concrete on all sides. Boxes shall be secured-in-place to keep boxes from moving during pouring of the building floor slab.
2. Set box in concrete such that the top of the box is even with the top of the unfinished slab.
3. Infill the removable lid with the same material as the floor covering.
4. Installations that are not level, flush with floor or aligned with furniture shall be removed and replaced.
5. Conduits shall enter openings provided in the sides of the box. Under no circumstances shall openings be field cut or shall conduits enter openings in the bottom of box.
6. Temporary covers shall remain in place until floor covering is installed. Temporary covers shall be delivered to the Using Agency upon completion of the work.

3.15 ROUGH-IN FOR DIVISION 27 SYSTEMS AND USING AGENCY PROVIDED TELECOMMUNICATIONS SYSTEMS:

A. Provide all outlet and junction boxes, sleeves and raceways to form an accessible pathway from each wall or floor mounted device, and ceiling mounted devices to the IDF or MDF or headend equipment location in which the cable terminates, as specified herein and as indicated on the drawings. Cable trays are specified in Section 261020.

B. Conduit sizes shall conform to the following:

1. Voice / Data / Video outlet: 2-1"
2. Voice / Data outlet: 2-1"
3. Video outlet: 3/4"
4. Fire alarm outlet: 3/4"
5. Other: 3/4"

C. Raceways shall be labeled to the extent necessary to allow easy identification by the cable system installers.

D. Outlet box mounting height, cover type, and alignment shall be governed by Division 27.

E. Refer to Section 27 90 10 for additional requirements. Pay particular attention to the requirement that the fire alarm system wiring shall be installed in a complete raceway system.

3.16 ROUGH-IN FOR DIVISION 23 CONTROL WIRING:

A. Provide all outlet and junction boxes, sleeves and raceways to form an accessible pathway from each wall mounted device to the associated control equipment. Rough-in details shall be similar to that shown for Division 27 devices.

3.17 SPECIAL PROVISIONS FOR DEVICES INSTALLED IN MILLWORK:

A. The millwork shall be provided with openings to accommodate device outlet boxes.

B. Serve all “islands” from concealed stubup.

1. Power wiring within millwork may be flexible metallic conduit.
2. Low voltage cables for Division 27 systems are not required to be installed in raceway within the millwork as long as the cables are accessible.

3.18 ROUGH-IN AND CONNECTIONS FOR ELECTRONIC DOOR HARDWARE:

A. Provide raceways and 120V power connections as indicated on the drawings.

3.19 FIRESTOPPING:

A. Do not proceed with firestopping until the field demonstration has been conducted.

B. Seal all penetrations based on rating / element being penetrated. Penetrations in non-rated walls shall be rated 1–hour.

END OF SECTION 26 10 10

SECTION 26 10 20 - CABLE TRAYS FOR LOW VOLTAGE SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SCOPE OF WORK:

A. Provide cable tray system in areas indicated, complete with all supports, fittings and accessories.

B. Only low voltage power-limited cables provided under Divisions 27 and 23 shall be installed in the cable trays. Installation of cables shall be as specified in Section 279010.

1.3 QUALITY ASSURANCE:

A. Acceptable Manufacturers

1. B-line.
2. GS Metals.
3. Panduit.
4. Cablofil.
5. Cope

B. Submittals: Refer to Section 260120 for requirements.

PART 2 - PRODUCTS

2.1 CABLE TRAYS:

A. Tray shall be welded wire-mesh type, nominal 4" deep. The mesh shall be nominal 2" x 4", using 0.2" diameter electro-galvanized steel wires. Tray width shall be 18".

B. Tray shall be suitable for pendant or wall mounting.

C. All fittings, inserts, covers, couplings, connectors and other accessories required to effect a complete rigid mechanical installation shall be provided and shall be listed as suitable for use with cable tray.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Layout of cable tray is the responsibility of the Contractor. Coordinate location with building structure and other trades to ensure that the tray is readily accessible and that cables installed therein do not pass within 6" of sources of electrical interference, such as fluorescent ballasts, motors and similar items. Tray shall not be installed more than 18" above ceilings, without written permission by the Architect.

B. Subject to the Architect's approval, tray runs may be discontinuous, to avoid obstacles such as ducts or structural elements, for a maximum of six feet. In such cases, each section shall be grounded.

C. Sections of tray shall be joined using a manufacturer's bolted connection. Bends shall be made using bolt cutters as recommended by the manufacturer. All edges shall be free from burs.

D. The tray shall be supported on 6- foot centers, maximum, by one of the following means:

1. Wall mounted: B-Line B18X wall bracket, attached to a 1-5/8" x 1-5/8" steel channel. Channel shall be fastened to the wall in a minimum of 2 places, one above and one below the wall bracket.
2. Pendant: 0.50 inch diameter threaded steel rod connected to a 1-5/8" x 1-5/8" steel channel below and spanning the width of the tray. The upper end of the rod shall be attached directly to the structure or attached to 1-5/8" x 1-5/8" steel channel span between adjacent structural members. Unless shown otherwise, the contractor may use either, or a combination of these methods.

E. Provide additional supports at the points of tendency of all bends and at all take-offs such as tee fittings.

F. Bracing and Leveling: Brace trays on intervals required to prevent lateral movement. After installation of cables by other trades, adjust supports and braces so that tray is level.

G. Conduits containing low voltage cables, that terminate at tray, shall be supported within 6" of tray, independent of tray supports.

H. Ground cable trays to the nearest 120/208V panel using a No. 6 THWN conductor installed in 1/2" conduit. Where tray sections are discontinuous, provide bonding jumper between adjacent sections. Bonding jumper shall be No. 6 THWN, installed to prevent physical damage).

END OF SECTION 26 10 20

SECTION 26 20 10 - WIRES AND CABLES, 600V AND BELOW

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SCOPE OF WORK:

A. The requirements of this section apply to the wire and cable work installed under this contract.

1.3 QUALITY ASSURANCE:

A. Acceptable Manufacturers: Provide wires and cables from manufacturers who have been in business for a minimum of five years.

B. Submittals: Refer to Section 260120 for requirements.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Wires and cables manufactured more than 12 months prior to date of delivery to the site shall not be used.

B. Color Coding

1. Color shall be green for grounding conductors.

2. The color of the circuit conductors shall be as follows:

120/208 volt, 3-phase	Phase A - Black Phase B -Red Phase C - Blue Neutrals – White (with stripes as specified below)
277/480 volt, 3-phase:	Phase A - Brown Phase B - Orange Phase C - Yellow

Neutrals – Gray (with stripes as specified below)

C. All conductors shall be 600V copper, with 75 degrees C, THWN/THHN insulation. Minimum size shall be No. 12 AWG. Conductors within three inches of fixture ballasts shall be rated 90 degrees C. Sizes up to No. 10 AWG may be stranded; sizes No. 8 AWG and larger shall be concentric-lay-stranded. All control conductors shall be concentric-lay-stranded.

PART 3 - EXECUTION

3.1 INSTALLATION GENERAL:

A. No more than three phase conductors, each of opposite phases for a three phase WYE system, shall be combined in a single raceway without written permission from the Architect.

B. For each ungrounded conductor, provide a dedicated neutral conductor, with stripe color to match ungrounded conductor insulation color.

C. For each electrical connection/termination, provide a complete assembly of materials, including but not necessarily limited to, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire nuts, and other materials necessary to complete splices and terminations. Torque all connections according to installation instructions.

D. Motor connections shall be made with compression connectors forming a bolted in-line or stub-type connection. Connections shall be insulated with Raychem MCK motor connection kit.

E. Splicing of feeder conductors shall not be acceptable, unless specifically indicated on the drawing. Where splicing of feeder conductors is indicated, splices shall be made using Raychem RVS splice kit and compression type butt splice

F. Numbers 10 and 12 AWG stranded conductors shall not be directly terminated to screw-type terminals. The use of Stacon type compression connectors is required.

G. All conductors shall be installed in raceways.

H. Make connections to wiring devices using "pigtails" within outlet boxes. *Direct connection (loop) to devices is not acceptable.*

3.2 DISTANCE LIMITATIONS FOR 20A BRANCH CIRCUITS:

I. All 120 volt, 20 amp branch circuits:

1. Exceeding 70 feet in length shall consist of No. 10 AWG circuit conductors.
2. Exceeding 115 feet in length shall consist of No. 8 AWG circuit conductors.

3. Exceeding 180 feet in length shall consist of No. 6 AWG circuit conductors.
4. Increase conduit size accordingly.

J. All 277 volt, 20 amp branch circuits:

1. Exceeding 140 feet in length shall consist of No. 10 AWG circuit conductors.
2. Exceeding 225 feet in length shall consist of No. 8 AWG circuit conductors.
3. Exceeding 365 feet in length shall consist of No. 6 AWG circuit conductors.
4. Increase conduit size accordingly.

END OF SECTION 26 20 10

SECTION 26 20 20 - WIRING DEVICES

PART 1 -GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SCOPE OF WORK:

A. The requirements of this section apply to all wiring devices installed under this contract.

1.3 QUALITY ASSURANCE:

A. Acceptable Manufacturers:

1. Provide devices by manufacturers listed for each item.

B. Occupancy/Vacancy sensor catalog numbers and locations shown on plans and specifications are for representation purposes only. Exact models and mounting locations shall be provided by sensor manufacturer. System drawings including device layout, device type, and wiring details shall be submitted for review in shop drawing phase prior to ordering. All sensors shall be dual technology.

C. Submittals: Refer to Section 260120 for requirements.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Provide factory-fabricated wiring devices, in type, color and electrical rating for the service indicated. Where type and grade are not indicated, provide proper selection as determined by Installer to fulfill the wiring requirements, and complying with NEC and NEMA standards for wiring devices.

B. Device colors shall be selected by the Architect on an area-by-area basis.

2.2 GENERAL USE RECEPTACLES:

A. Standard Tamper Resistant (Heavy Duty Specification Grade): Hubbell 5362TR, Arrow Hart TR5362, or Pass & Seymour TR5362.

B. Ground-Fault Tamper Resistant Receptacles (Heavy Duty Auto Grounding): Hubbell GFTRST20, Arrow Hart TRSGF20, or Pass & Seymour 2097TR.

C. Receptacles shall be 2-pole, 3-wire, grounding type, rated 20A/125V.

D. Provide weather resistant receptacles in all outdoor locations.

2.3 SPECIAL PURPOSE RECEPTACLES:

A. Provide heavy-duty type of the NEMA configuration indicated on the drawings, as manufactured by Hubbell, Arrow Hart, or Pass & Seymour.

2.4 SWITCHES:

A. Toggle (Industrial Extra Heavy Duty Specification Grade): Hubbell HBL1221, Arrow Hart AH1221, or Pass & Seymour PS20AC1. Provide single-pole, three-way and four-way switches as indicated. Catalog numbers listed herein are for single pole units. Other configurations shall be from the same product family.

B. Keyed: Key switches shall be rated same as toggle switches but shall have cylindrical locking mechanism. *Fork-type keys are not acceptable*. Provide 6 keys to the Owner at the time of final inspection.

C. Switches installed adjacent to dimmers shall be of the same type and style as dimmer.

D. Narrow-body switches for installation in door-jambs shall not be used.

E. Switches shall have ground screw.

2.5 OCCUPANCY/VACANCY SENSORS:

A. Corner Mounted: Dual technology (Ultrasonic & Infrared), ceiling or wall bracket mounted. Select based on size of space. Provide power pack and mounting hardware; suitable for switching 120 and/or 277 volt loads. Watt-Stopper DT-200 series, Hubbell LODT series, or equivalent by Cooper or Sensor Switch.

B. Ceiling Mounted: Dual technology (Ultrasonic & Infrared), ceiling mounted. Select based on size of space. Provide power pack and mounting hardware; suitable for switching 120 and/or 277 volt loads. Watt-Stopper DT-300 series, Hubbell OMNIDT series, or equivalent by Cooper or Sensor Switch.

C. Wall Mounted: Dual technology (Ultrasonic & Infrared), wall bracket mounted. Select based on size of space. Suitable for switching 120 and/or 277 volt loads. Watt-Stopper DW-100 series, Hubbell LHMTS1 series, or equivalent by Cooper or Sensor Switch.

D. The triggering of only one technology shall keep the fixtures on.

E. Power packs for sensors shall be rated for control of fractional horsepower motor loads in conjunction with the respective lighting load. Low-voltage multi-conductor cable between sensors and power packs shall be plenum rated, 22 AWG.

F. Provide auxiliary contacts in sensors where shown on the project drawings, or as otherwise required for the functionality specified in the particular building space.

2.6 WIRING DEVICE ACCESSORIES:

A. Wall Plates: Provide one piece wall plates for wiring devices, with ganging and cutouts as indicated. Provide blank plates for all unused outlet boxes. Provide with metal screws for securing plates to devices, screw heads colored to match finish of plate, and wall plates possessing the following additional construction features:

1. Material and Finish: Type 302 stainless steel in finished spaces and stamped steel in unfinished spaces.
2. All plates shall be jumbo size.

B. Weatherproof Covers: All devices installed outdoors shall be provided with weather proof covers. Covers shall be Intermatic die-cast WP series (or equivalent), single or two gang type. The assembly shall be U.L. listed for wet locations, when in use.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRING DEVICES:

A. General:

1. Devices of the same type shown side-by-side shall be gang-mounted and installed under a common plate unless specifically noted.
2. Do not install receptacles within 6" of the edge of sinks.
3. Provide weatherproof covers for all devices installed outdoors.
4. All receptacles installed outdoors, all kitchen receptacles, and receptacles within six feet of sinks and other interior receptacles specifically indicated shall be GFCI type.
5. All receptacles installed outdoors shall be weather resistant GFCI type.
6. Coordinate location of electric water cooler receptacles with cooler manufacturer’s recommendations.

B. Connections:

1. Make connections to side terminals only. Wrap side of device with two complete turns of 600V electrical tape, to cover the exposed terminals.
2. See Section 262010 for conductor requirements.

C. Labeling:

1. Provide engraved device plates where indicated. Use 1/8" high black letters.
2. Device plates for receptacles in patient care areas shall have circuit designation engraved in 1/8" high black letters.
3. Mark the branch circuit to which the device is connected on the back of each device plate, using an indelible marker pen.

3.2 DIMMERS:

A. In multi-circuit homeruns, provide separate neutrals for each circuit. Do not use a common neutral.

3.3 OCCUPANCY/VACANCY SENSORS:

A. Corner mounted sensors shall be ceiling bracket mounted where ceiling is present and no higher than 12’ AFF. Where space has no ceiling or ceiling is higher than 12’ AFF, the corner mounted sensor shall be mounted 10’ AFF on a manufacturer-supplied wall bracket.

B. Sensors shall be installed in locations shown on manufacturer submitted shop drawings.

C. Wall mounted sensors shall also be configured to operate automatic-on/automatic-off, in configuration shown on plans.

D. Manual switches are not required in corridors, stairwells or, multiple occupant restrooms. Sensors shall be automatic-on/automatic-off in these spaces.

E. Low-voltage sensor cable shall be supported by j-hooks attached to structural members, and shall be run at right angles with respect to building structure.

F. Adjust time-off delay to a minimum of fifteen minutes

A. Prior to project closeout, the Manufacturer and/or his designated Representative shall test and adjust ALL occupancy sensors on a space by space basis. Adequate personnel shall be provided to perform this work in a timely fashion. Delay times shall be coordinated with the Owner’s Representative. Sensor sensitivities shall be adjusted as necessary for optimum performance and to minimize false activations from movement in adjacent spaces. If optimum performance of occupancy sensors cannot be achieved with installed device quantities and locations, adjustments to the quantity and/or location of the occupancy sensors shall be performed at no additional cost to the Owner. Retest and adjust occupancy sensors as appropriate. At the conclusion of commissioning, the Manufacturer and/or his Designated Representative shall submit a comprehensive and detailed testing report as part of the as-built submittal package. Changes to the original manufacturer’s layout submitted as part of the Division 26 submittal package shall be annotated on the as-built layout drawings.

3.4 TESTING:

A. Test all devices to ensure proper polarity and grounding.

3.5 PROTECTION:

A. If painting and other finish work occurs after device installation, protect device and conductors by installing and maintaining temporary cover:

END OF SECTION 26 20 20

SECTION 26 20 21 - SAFETY AND DISCONNECT SWITCHES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SCOPE OF WORK:

A. The requirements of this section apply to all safety and disconnect switches installed under this contract.

1.3 QUALITY ASSURANCE:

A. Manufacturers: Provide products produced by one of the following (for each type of switch):

1. General Electric Company
2. Square D Company
3. Eaton/Cutler Hammer
4. Siemens

B. Submittals: Refer to Section 260120 for requirements.

PART 2 - PRODUCTS

2.1 SAFETY AND DISCONNECT SWITCHES:

A. Switches shall be 600V heavy duty type, sheet steel enclosed safety switches, incorporating quick-break type switches, constructed so switch blades are visible in "OFF" position with the door open. Switches shall be equipped with operating handles which are an integral part of the enclosure base and whose positions are easily recognizable. Switches shall be pad-lockable in the "OFF" position. All current carrying parts shall be constructed of high-conductivity copper and silver-tungsten type switch contact. All switches shall be UL listed. Switches shall have engraved plastic nameplates indicating the load served, load rating and the branch circuit number.

Example – (not actual disconnect on project): HP-1
35.5A, 1ph, 208V
Fed from HA-2

B. Switches shall be non-fused type unless indicated otherwise or unless required by the manufacturer of the driven equipment. Where fuses are required, provide fuses of the type recommended by the equipment manufacturer.

C. **Nameplates shall be screwed and glued to the enclosure.**

2.2 MOTOR RATED SWITCHES:

A. Switches shall be toggle-type, without overload protection, rated for the applied voltage and motor load.

B. Label same as specified for disconnect switches, except install label on wall adjacent to switch.

2.3 ARC FLASH WARNING LABELS:

A. All safety and disconnect switches shall have arc flash warning labels field affixed to their enclosures that comply with the requirements of NFPA 70 and NFPA 70E.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Coordinate safety and disconnect switch installation with surrounding equipment to provide clearance and workspace based on the voltage encountered, and to insure that the switch is within sight of the controller or driven equipment.

B. Group and lace conductors within enclosure with nylon tie straps.

C. **Location of safety switches shall be coordinated with the equipment installer.** Do not proceed with rough-in until location has been established.

D. All switches associated with outdoor equipment shall be located as close to the equipment as possible (when equipment is in a service yard, switches shall also be in the service yard) and mounted such that the top of the switch is no more than 3'-0" above grade. All switches associated with equipment mounted above a lay-in ceiling shall also be located above the lay-in ceiling.

END OF SECTION 26 20 21

SECTION 26 20 30 - LIGHTING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION:

A. This section of the specifications is applicable to all lighting fixtures and fixture accessories.

B. Fixtures shall be furnished with ballasts installed. Lamps shall be furnished separately, from the lamp manufacturer.

1.3 QUALITY ASSURANCE:

A. CBM Label: Provide ballasts which comply with Certified Ballast Manufacturers Association standards and carry the CBM mark on the label.

B. Acceptable Manufacturer's:

1. Lighting fixtures - see fixture schedule on drawings.
2. Ballasts - Magnetek-Universal or equivalent by Motorola or OSRAM Sylvania.
3. Dimming Ballasts – Lutron, Advance, Universal (10-100% dimming range).
4. Lamps - General Electric, Phillips or OSRAM Sylvania.

C. Submittals: Refer to Paragraph 3.05 and Section 260120.

PART 2 - PRODUCTS

2.1 LIGHTING FIXTURES:

A. Provide lighting fixture assemblies complete with all hardware and accessories needed to install and connect, as indicated on the drawings and this section of the specifications.

B. The Contractor shall select the voltage, frame type, ballast temperature rating and number of ballasts, based on the use shown, on an area-by-area basis. These modifiers are not included in catalog numbers. (i.e. A given fixture may be required for use on more than one voltage. Determine voltage by circuit to which fixture is connected.)

C. Any fixtures that are defective or damaged shall be replaced with new. This includes, but is not

limited to scratches, dents, inconsistent finishes, etc. The Architect's opinion shall be final in making the determination.

D. Lampholders and sockets shall be compatible with lamp / ballast combinations used.

2.2 LED Lamps and Fixtures:

A. General:

1. LED lamps and driver shall have a 5 year warranty or longer.
2. LED fixtures shall have minimum rated life of 50,000 hours or longer per LM 80 and LM 70 standards.
3. Replacement lamps shall have minimum efficiency of 70 lm / W per LM 79 testing.
4. Integral LED lamps shall have minimum efficiency of 90 lm / W per LM 79 testing.
5. Refer to light fixture schedule on drawings for color temperature.
6. Provide minimum Color Rendering Index, CRI, of 80.

2.3 EMERGENCY DRIVERS:

A. Emergency drivers shall be factory installed.

B. Drivers installed in fixtures located outdoors or unheated spaces shall be suitable for the ambient temperatures encountered.

C. LED Emergency drivers shall be IOTA ILB-CP10 or equal by Bodine. LED emergency driver shall provide a minimum of 10W of power through constant power technology for 90 minutes. Driver shall have a 5-year warranty.

2.4 FRAMES AND HOUSINGS:

A. Fixture catalog numbers indicate style of fixture required. Provide fixtures with proper frames for ceiling types indicated on the reflected ceiling plan.

B. Fixtures installed in inaccessible ceilings shall be U.L. approved for through wiring and all components shall be accessible from below.

2.5 PENDANT MOUNTED FIXTURES:

A. Provide fixtures of lengths indicated.

B. Provide all suspension assemblies, canopies and accessories required for complete installation.

C. Linear type fixtures shall be supported at all points with stainless steel aircraft cable or rigid stems, as indicated.

1. General:

a. Provide only one feed point per row of fixtures, unless separate emergency power connection is required.
b. Provide supports at every fixture junction and terminus and as stipulated by the manufacturer.

2. Aircraft cable:
   a. Provide manufacturer's stainless steel aircraft cable assembly with canopy, for the specific fixture series.
   b. Provide non-coiled cable securely attached to aircraft cable at feed points.
3. Rigid stems:
   a. Provide manufacturer's stem-canopy for the specific fixture series.

D. Circular type fixtures shall be provided with suspension assemblies specified for each fixture type.

E. Installation drawings shall be provided for each room, as specified in Section 260120. Show all points of support and feed locations.

F. Provide one pint of touch-up paint for each fixture type and color.

2.6 COLORS AND FINISHES :

A. The color / finish of all surface and pendant mounted fixtures and all suspension assemblies, canopies and accessories shall be selected by the Architect, from the manufacturer's premium color / finish group. Submittals shall include color charts of the colors / finishes available.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. General:

1. Do not use permanent fixtures to provide temporary construction lighting. No fixture shall be installed until the interior of the building is enclosed, conditioned, clean and free of dust.
2. Install lighting fixtures in accordance with the fixture manufacturer's written instructions
3. Fasten fixtures securely to the indicated structural support members of the building; and check to ensure that solid pendant fixtures are plumb.
4. Lay-in fixtures shall be supported independently of the suspended ceiling framing members by at least two tie wires located on opposite corners of each fixture.
5. Fixtures other than lay-in type shall be securely fastened in accordance with NEC Article No. 410-36 (B).
6. Fixtures installed in rated ceilings shall comply with the U.L. Fire Resistance Directory for the ceiling design encountered.

B. Layout:

1. Locate fixtures as indicated on the reflected ceiling plans.

C. Recessed Fixtures:

1. It is anticipated that piping and ductwork systems will be installed prior to the installation of ceiling systems and lighting fixtures. Coordinate recess depth of fixtures, on an area-by-area basis, with other trades, to ensure that sufficient recess depth is maintained.
2. Maintain clearance from thermal insulation and combustible materials as required by the NEC.

D. Pendant Mounted Fixtures:

1. Install fixtures at the heights indicated on the reflected ceiling plans. Fixtures or rows of fixtures shall be true and level.
2. Suspension assemblies shall be rigidly attached to the building structure. Suspension assemblies shall allow field adjustment of +/- 12".

E. Emergency fixtures:

1. Where emergency fixtures with integral emergency drivers are shown to be switched, pull an unswitched phase conductor to emergency driver.
2. Do not switch exit lights.

3.2 AIMING:

A. Aim adjustable fixtures to provide a uniform wash of the surface or area to be illuminated.

3.3 LAMPS:

A. Follow the manufacturers' instructions regarding the handling of lamps while installing.

3.4 CLEANING:

A. Prior to final inspection, clean lighting fixtures in a manner recommended and approved by the manufacturer.

B. Replace any components that are damaged.

C. Specific attention is directed to the appearance of pendant mounted fixtures. Field touch-up of the finish will only be acceptable when:

1. The level of damage to the finish does not require replacement of the product, in the sole opinion of the Architect.

AND

2. The Contractor ordered and took delivery of touch-up paint, as well as the manufacturer's recommendations on touch-up, at the time the product was ordered.

AND

3. The touch-up is acceptable to the Architect.

3.5 SPARE PARTS:

A. Provide 12 spare exit lights and 25' of associated raceway and conductors to connect to nearest un-switched lighting circuit. Spare signs shall be added in locations where the Authority Having Jurisdiction requires.

B. Provide 12 spare emergency ballasts for linear fluorescent fixtures. Spare ballasts shall be installed in already placed fixtures where Authority Having Jurisdiction requires.

C. If spare equipment listed above are not needed for installation, turn over to Owner.

3.6 TESTING:

A. Test all fixtures for proper operation. Replace lamps and ballasts that are not working properly.

B. Test the emergency lighting system by opening the main circuit breaker serving the facility.
   1. Schedule the test with all trades to ensure the tests will not have adverse effects on other equipment and to make sure that other systems properly shut-down and restart.
   2. The test shall be conducted at night, in the presence of the Architect, Using Agency and State Fire Marshal.
   3. The assembled persons will walk the project to:
      a. Verify operation of equipment installed.
      b. Review lighting levels on an area-by-area basis.

END OF SECTION 26 20 30

SECTION 26 20 40 - MOTOR STARTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SCOPE OF WORK:

A. Individual low-voltage motor controllers or starters shall be furnished for each piece of driven equipment if not furnished integrally.

B. All motor controllers furnished shall be horsepower rated in NEMA Standard sizes for the size motor served, shall comply with all UL, NEC, and NEMA requirements, and shall provide overload protection in every ungrounded phase conductor servicing each motor. IEC controllers shall not be acceptable. All overload units for controllers shall be ambient-compensated type when controllers are located in a varying temperature atmosphere and the motor is located in a constant temperature atmosphere.

1.3 QUALITY ASSURANCE:

A. Acceptable manufacturers:
   1. Square D Co.
   2. Eaton/Cutler Hammer
   3. Siemens

B. Submittals: Refer to Section 260120 for requirements.

PART 2 - PRODUCTS

2.1 MANUAL CONTROL:

A. For 115 volt, single phase motors, motor controllers shall be toggle-type, manually operated thermally protected, across-the-line starting type, unless otherwise indicated or unless automatic starting is required. Controller shall also serve as the disconnecting means unless indicated otherwise.

B. Provide NEMA 1 enclosure for all indoor, dry locations and NEMA 3R enclosure for outdoor or wet locations.

2.2 AUTOMATIC CONTROL:

A. For 3 phase motors 25 HP and smaller, motor controllers shall be magnetically operated, across-the-line starting type, unless otherwise indicated. 30 HP and larger shall use reduced voltage auto-transformer type units. Starters shall be equipped with Hand-Off-Automatic switch.

B. Combination motor controllers shall have externally operated molded-case circuit breakers properly sized for the motor or equipment serviced, mounted and factory wired in the same enclosure with the motor controller. Controllers for motors 25 HP and larger, shall also have phase failure relays.

C. Control power transformers complete with necessary fuses shall be provided, unless otherwise indicated, in the motor controller enclosure for all electrically operated motor controllers and associated control equipment. Control voltage shall be 120 volts, 60 Hz., unless otherwise indicated. Transformers shall be adequately sized for operation of the motor controller and auxiliary equipment associated therewith.

D. Necessary extra interlocks and cover mounted control devices, as required, shall be provided.

E. Provide red "run" pilot light and blue "overload" pilot light in cover.

F. Starters shall have engraved plastic nameplates indicating the load served, load rating and the branch circuit number. Nameplates shall be screwed and glued to enclosure.

Ex: EF-1
2HP, 3 phase, 208V
HA-1

G. Provide NEMA 1 enclosure for all indoor, dry locations and NEMA 3R enclosure for outdoor or wet locations.

2.3 ARC FLASH WARNING LABELS:

A. All motor starters shall have arc flash warning labels field affixed to their enclosures that comply with the requirements of NFPA 70 and NFPA 70E.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Installation by the Contractor shall include firmly mounting motor controllers with overload re-set button or switch, or with operating handle of circuit breaker or switch for combination types, not over 6'-6" above the floor or finished grade, All bolts, lugs and other connections shall be checked for tightness. All moving parts shall be checked for proper alignment and freedom of movement. All time-delay or sequencing relays shall be checked and properly adjusted or set.

B. Coordinate controller installation with surrounding equipment to provide clearance and workspace based on the voltage encountered.

C. Controllers shall be checked for installation of properly sized overload heater units and all breaker instantaneous trip units shall be set as low as possible to allow motor to start.

D. All motors on motor operated equipment shall be checked for proper rotation.

END OF SECTION 26 20 40

SECTION 26 20 42 - PANELBOARDS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SCOPE OF WORK:

A. Provide panelboards as indicated on the drawings and as specified herein.

1.3 QUALITY ASSURANCE:

A. Manufacturers: Provide products by one of the following (for each type of panelboard and enclosure).

1. Square D Co.
2. Eaton/Cutler Hammer
3. Siemens

B. Compliance / Labels:

1. Equipment shall comply with the latest applicable standards of NEMA PB-1 and UL 67.
2. Where panelboards are used as service entrance equipment, they shall comply with all NEC and UL requirements for service entrance and a UL service entrance label shall be provided.

C. Submittals: Refer to Section 260120 for requirements.

PART 2 - PRODUCTS

2.1 ENCLOSURES:

A. Enclosure shall be constructed of code gauge steel constructed **without** knock-outs. Provide manufacturer's standard light gray finish.

B. Provide double hinged door with flush metal latch/lock on inner door. Inner door shall provide access to circuit breaker operating handles only, not to energized parts. Outer continuous piano hinged door shall be mounted to the panelboard box with factory screws and shall provide access to energized parts; metal latch/lock is not permissible on outer door. Both inner and outer doors shall open in same direction. **EZ Trim doors are not permitted.**

C. All locks shall be keyed alike.

D. Provide metal or lexan interior circuit directory frame with card and clear plastic covering.

E. Panelboard enclosures shall be NEMA 1 unless shown to be installed in damp or wet locations. In such locations, enclosures shall be NEMA 3R or 4X.

2.2 CONSTRUCTION:

A. Provide dead-front safety type panelboards of either Power and Distribution type or Lighting and Appliance type as defined by the NEC.

1. Power and Distribution type panelboards shall be a minimum of 32” wide by 9” deep and a maximum of 44” wide by 12" deep.
2. Lighting and Appliance type panelboards shall be a maximum of 20 inches wide by 5-3/4 inches deep.

B. Panels shall be equipped with copper bus bars, full-sized neutral bar**,** and an equipment ground bus. Panels serving computer receptacles shall have a isolated ground bus in addition to the equipment ground bus.

C. Each panel shall be equipped with main lugs or main breaker, as indicated.

D. Two section panels shall be through-feed type and shall be installed with cans abutting. *Cans and covers shall be of same size, for both sections.* Divide circuits as evenly between the two sections as possible.

E. Provide with laminated plastic nameplate engraved with name of panel, voltage, ampere rating/type fault current rating, date, and feeder origination. Nameplate shall be screwed and glued to panel. Nameplates shall be black in color with white lettering. Nameplates shall have beveled edges.

Example (not actual panel on project): Panelboard HA
277/480V, 3 phase, 4W
225A Main Lugs
14,000 AIC
Fed from SWBD
9/2008

2.3 CIRCUIT BREAKERS:

A. Provide bolt-in type, heavy duty, quick-make, quick-break, thermal, magnetic molded case circuit breakers. **Multi-pole breakers shall be common trip, with a single handle**.

B. Main circuit breakers shall be large frame type, individually mounted, connected directly to the bus. The use of back-fed breakers is not acceptable.

C. Provisions for future breakers shall be fully bussed complete with all necessary mounting

hardware.

D. Devices which achieve the level of fault protection indicated by means of "series" or "integrated" rating shall not be acceptable unless specifically indicated on the drawings.

E. Breakers serving HVAC equipment shall be HACR type.

F. Circuit breakers serving fire alarm equipment shall be provided with a lock tab, red in color.

2.4 BRANCH CIRCUIT IDENTIFICATION:

A. All panelboards shall have a legend permanently posted to their exterior frontal enclosure identifying phasing and the color scheme of all ungrounded conductors in accordance with NFPA 70, Article 210.5.

2.02 SELECTIVE COORDINATION FOR EMERGENCY POWER SYSTEMS:

A. All emergency power system overcurrent devices shall be selectively coordinated with all supply-side overcurrent protective devices to comply with the requirements of NFPA 70 Articles 700 and 701.

B. The contractor shall furnish protective device coordination studies which shall be prepared by the equipment manufacturer. The studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer or other qualified persons engaged primarily in the design, installation, or maintenance of electrical systems and skilled in performing and interpreting the power system studies. The Registered Professional Electrical Engineer or other qualified person shall be a full-time employee of the electrical power equipment manufacturer.

C. Protective Device Coordination Study:

1. The results of the protective device coordination study shall be summarized in a final report and submitted with the shop drawings.
2. The report shall include protective device time versus current coordination curves with associated one-line diagram identifying the plotted devices, tabulations of adjustable circuit breaker trip unit settings. Comments and recommendations for system improvements shall be provided where needed.
3. Proposed protective device coordination time-current curves shall be graphically displayed on log-log scale paper.
4. Include on each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered.
5. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
6. Identify device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
7. Provide adequate time margins between device characteristics such that selective operation is provided while providing proper protection.

D. Field Adjustment: Adjust protective device settings according to the recommended settings table provided by the coordination study.

2.03 METERING:

A. On panelboards used as service equipment, provide Siemens 9330, complete with current transformers and interconnecting wiring, all rated for 1% accuracy. Unit shall be factory installed and tested. Flush mount meter in termination compartment. Equivalent metering by Westinghouse, G.E. or Square D is acceptable.

2.5 WARNING LABELS:

A. All panelboards shall have arc flash warning labels field affixed to their enclosures that comply with the requirements of NFPA 70 and NFPA 70E.

B. Where panelboards are used as service equipment, provide separate label to show the maximum available fault current. Label shall have blank fields to handwrite the calculated available fault current and the date calculated. After service is installed and ready to be inspected by the Authority Having Jurisdiction, Contractor shall submit to the Electrical Engineer the fault calculation (at the service entrance only).

PART 3 - EXECUTION

3.1 GENERAL:

A. Provide circuit directory upon completion of work. Identify load served and location (by room name and number) assigned by user, not by room numbers on floor plans. Note spares and spaces as such. Create directory using electronic spreadsheet and print in 8-1/2" x 11" format using as many pages as necessary. Fold and place in directory holder.

B. Do not splice conductors in panelboard enclosure.

C. Only one conductor shall be connected to each terminal or lug.

D. Connect circuits 1 and 2 to phase A; 3 and 4 to phase B; 5 and 6 to phase C., etc. Conductors shall be color coded in accordance with Section 262010.

E. Group and lace conductors within panel enclosure with nylon tie straps.

F. Each section of two section panels shall contain only those conductors which originate in that section. Do not use panel as a wireway.

3.2 GROUNDING:

A. Ground all panels in accordance with details on the drawings and Section 262080.

B. Do not bond neutral and equipment grounding conductors within panelboard unless panel is used as service equipment or are a separately derived system.

3.3 ADJUST AND CLEAN:

A. Adjust operating mechanism for free mechanical movement.

B. Touch-up scratched or marred surfaces to match original finish.

C. Clean all debris from panel interiors.

D. Clearance and Workspace: Maintain workspace and clearances as required by the NEC for the voltage encountered. No pipes or ducts shall pass above the outline of the panelboard. It shall be the responsibility of this Contractor to make sure that other trades do not encroach on this space.

END OF SECTION 26 20 42

SECTION 26 20 44 - SEPARATELY ENCLOSED CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SCOPE OF WORK:

A. Provide circuit breakers of ratings as indicated on the drawings and as specified herein.

1.3 QUALITY ASSURANCE:

A. Acceptable Manufacturers:

1. Square D Co.
2. Eaton/Cutler Hammer
3. Siemens

B. Compliance/Labels:

1. Equipment shall comply with the latest applicable standards of NEMA PB-1 and UL 67.
2. Where circuit breakers are used as service entrance equipment, they shall comply with all NEC and UL requirements for service entrance and UL service entrance label shall be provided.

C. Submittals: Refer to Section 260120 for requirements.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Provide circuit breakers, enclosures and auxiliary components of types, sizes and ratings indicated. Enclosure shall be NEMA 1 indoors, NEMA 3R outdoors and be constructed of code gauge steel constructed without knock-outs. Provide manufacturer’s standard light gray finish.

2.2 CIRCUIT BREAKERS:

A. Circuit breakers shall the same type as specified in the PANELBOARDS section.

2.3 NAMEPLATE:

A. Nameplates shall be the same as specified in the PANELBOARDS section.

2.4 SPECIAL PROVISIONS:

A. Circuit breakers located in elevator machine rooms, serving the elevator motor and car lights shall be provided with a shunt trip coil rated for 120V operation. Breaker shall also have a set of Form C contacts.

2.5 ARC FLASH WARNING LABELS:

A. All separately enclosed circuit breakers shall have arc flash warning labels field affixed to their enclosures that comply with the requirements of NFPA 70 and NFPA 70E.

PART 3 - EXECUTION

3.1 GENERAL:

A. Do not splice conductors in circuit breaker enclosure.

B. Group and lace conductors within enclosure with nylon tie straps.

3.2 ADJUST AND CLEAN:

A. Adjust operating mechanism for free mechanical movement.

B. Touch-up scratched or marred surfaces to match original finish.

END OF SECTION 26 20 44

SECTION 26 20 47 - DRY TYPE TRANSFORMERS, 600V AND BELOW

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SCOPE OF WORK:

A. Provide dry-type transformers of ratings indicated on the drawings and as specified herein.

1.3 QUALITY ASSURANCE:

A. Transformers shall be the standard product of one of the following manufacturers:

1. Square D Company
2. Siemens
3. Eaton/Cutler Hammer

B. Compliance: Comply with applicable UL, NEMA and ANSI publications pertaining to dry type transformers and their installation.

C. Submittals: Refer to Section 260120 for requirements.

PART 2 - PRODUCTS

2.1 TRANSFORMERS:

A. Individual dry type transformers shall be UL approved for 500 KVA and smaller, shall be sized as indicated on the drawings, shall be built in accordance with NEMA/ANSI standards, shall be self-cooled, two-winding type, and shall have totally enclosed **copper** windings. Transformers shall be rated for a **115 degrees C. rise** above ambient. Provide weather-proof enclosures for all units mounted in locations exposed to falling or driven rain.

B. Full capacity taps shall be provided in the high voltage windings and shall have 4-2-1/2% taps below and 2-2-1/2% taps above rated primary volts. Transformer impedance value shall be manufacturer's standard for size transformer provided.

C. Transformer sound levels shall be based on NEMA-ANSI standards. *However, no audible noise shall be heard outside the rooms in which transformers are located, under all load conditions. Transformers not meeting this requirement shall be replaced.*

D. Transformers shall have efficiencies in compliance with NEMA TP-1 standards.

2.2 ARC FLASH WARNING LABELS:

A. All dry type transformers shall have arc flash warning labels field affixed to their enclosures that comply with the requirements of NFPA 70 and NFPA 70E.

PART 3 - EXECUTION

3.1 TRANSFORMER INSTALLATION:

A. Installation of transformers shall be such that air circulation around the units is not restricted. Hold 6" off walls.

B. Under no circumstances shall transformer be hoisted into place before roof is in place and installed in such a manner that roof has to be removed to remove transformer.

C. The transformer taps shall be connected to provide proper operating secondary voltage.

D. Transformers shall be floor mounted type. Install on floor or suspend, as indicated on the drawings. Floor mounted transformers shall be installed on a 4" high concrete pad with 3" overlap on all sides. Anchor transformer to pad. *Coordinate exact placement with sprinkler system installer such that during normal operation, the heat rejected from transformer does not cause activation of sprinkler head.*

E. Transformers mounted indoors shall have neoprene, rubber or similar type vibration dampening mounts. All raceway connections shall be made with 12 to 18 inches of flexible metallic conduit.

F. Ground transformer secondary neutral to the nearest electrode in accordance with NFPA 70, Article 250-26c.

END OF SECTION 26 20 47

SECTION 26 20 49 - SURGE PROTECTION DEVICES (SPD)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SCOPE OF WORK:

A. Provide SPD units connected in parallel with power distribution equipment, as indicated. SPD units shall be mounted *external* to power distribution equipment. *The use of SS/EHF units integral with power distribution equipment is not acceptable.*

1.3 COORDINATION:

A. Work under this section shall be closely coordinated with power distribution equipment specified under other sections.

1.4 REFERENCE STANDARDS AND PUBLICATIONS:

A. Suppressors shall be designed, manufactured, tested and installed in accordance with the latest edition of the following guidelines and standards:

1. ANSI/IEEE C62.41.1 & C62.41.2
2. ANSI/IEEE C62.45.
3. UL 1449 Third Edition

B. Provide certification that product performance has been verified by a nationally recognized third party testing laboratory.

1.5 SUBMITTAL:

A. Refer to Section 260120 for requirements.

1.6 ACCEPTABLE MANUFACTURERS:

A. This specification is based on the following:

1. Square D
2. Surge Suppression, Inc.

3. Current Technologies
4. Advanced Protection Technologies
5. Liebert

PART 2 - PRODUCTS

2.1 GENERAL:

A. SPD for service equipment:

1. Type 1 device.
2. Voltage: 277/480V, 3Ph, 4W, 60 Hz.
3. Modes: L-L, L-N, L-G.
4. Single pulse surge capacity per mode: 240,000 amps.
5. Clamping Voltage: Manufacturer's rating per the distribution system's voltage.
6. Noise Attenuation: 100KHz - 100MHz.
7. Nominal Discharge Current (In) shall be a minimum of 20kA.

B. SPD for lighting and appliance panels:

1. Type 2 device.
2. Voltage: 120/208, 3PH, 4W, 60 Hz.
3. Modes: L-L, L-N, L-G, N-G.
4. Single pulse surge capacity per mode: minimum of 120,000 amps.
5. Noise Attenuation: 100KHz - 100MHz.
6. Nominal Discharge Current (In) shall be a minimum of 10kA

2.2 FEATURES:

A. All units shall have the following features:

1. Phase LED indicator lights.
2. Disturbance counter.
3. 10-year repair / replacement warranty from manufacturer in the name of the Owner.

2.3 ENCLOSURES:

A. SPD enclosures shall be NEMA 1 unless shown to be installed in damp or wet locations. In such locations, enclosures shall be NEMA 3R or 4X.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Provide a SPD unit on each piece of service entrance equipment.

B. Install adjacent to electrical equipment, ensuring that lead lengths are as short as possible to achieve the level of protection specified herein. Lead lengths longer than 12" is unacceptable. Where field conditions make this requirement impossible, contact Architect during shop drawing phase before electrical room drawings are submitted.

C. Connect to circuit breaker in electrical equipment as shown on the manufacturer's wiring diagrams.

END OF SECTION 26 20 49

SECTION 26 20 80 - ELECTRICAL GROUNDING, 600V AND BELOW

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK:

A. Provide grounding and bonding of systems and equipment as shown on the drawings, specified herein and as required by Article 250 of the NEC.

B. The grounding electrode system shall consist of:

1. Ground rods.
2. Underground metal water supply pipe, outside the building.
3. Concrete encased electrode
4. Ground ring - around the perimeter of the building.

C. The following items shall be bonded to the grounding system:

1. Structural steel frame of the building.
2. Interior metal piping systems.
3. Equipment enclosures.
4. Device terminals.
5. Equipment grounding conductors.
6. Lightning protection system (if specified).

1.3 RELATED WORK:

A. Grounding and bonding for Lightning Protection Systems is specified in Section 265000.

B. Grounding of systems above 600V is specified in Section 263030.

1.4 QUALITY ASSURANCE:

A. Acceptable Manufacturers: Use products of manufacturer’s regularly engaged in the production of grounding systems products.

B. Standards: IEEE Green Book - Grounding.

C. Compliance / Labels: All materials shall be U.L. listed for grounding and bonding systems.

D. Submittals: Refer to Section 260120 for requirements.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Where more than one type meets indicated requirements, selection is Installer's option. Where material or component is not otherwise indicated, provide products complying with U.L., NEC, and established industry standards.

2.2 GROUND RODS:

A. Rods shall be 3/4" diameter x 10' long copper-clad steel, sectional type.

B. Couplings shall be of the type specifically intended for use with sectional rods.

2.3 CONDUCTORS:

A. Grounding Electrode conductors: Bare, stranded copper electrical grounding conductors, sized as shown. When no size is shown, select from Table 250-66 of the NEC.

B. Bonding Jumper Braid: Copper braided type, sized for application.

C. Equipment Grounding conductors: Insulated, stranded copper electrical grounding conductors complying with Section 262010, sized as shown. When no size is shown, select from Table 250-122 of the NEC.

2.4 CONNECTORS:

A. Connectors to rod or reinforcing steel bar electrodes shall be exothermic weld type. The use of wire ties to make rebar continuous is not acceptable.

B. Connections to pipe electrodes shall be pressure or clamp type.

C. Connections to items specified to be bonded to the grounding system may be by any U.L. listed product suitable for the application.

2.5 CAUTION TAGS:

A. Tags shall be weatherproof, custom-printed plastic type, 3-1/4" wide x 5-5/8" high, with stainless steel eye and nylon self-locking tie.

B. Tags shall be two-sided and shall have yellow background with black letters. The word

"CAUTION" shall be machine-printed in boldface type at the top, with the custom message machine-printed below.

C. Provide the number of tags required, plus six spare.

D. Tags shall be Seton #12584, or equivalent. (Seton: 1-800-243-6624)

PART 3 - EXECUTION

3.1 GENERAL:

A. Ensure that metal-to-metal contact is made between grounding connectors and painted or coated surfaces of equipment enclosures, piping systems, etc.

B. Where concrete penetration is necessary, non-metallic conduit shall be cast flush with the points of concrete entrance and exit so as to provide an opening for the ground wire and the opening shall be sealed with a suitable compound after installation of the ground wire.

C. Metallic raceway systems shall be made electrically continuous to provide a low impedance path to ground for faults, as required by the NEC.

3.2 GROUNDING ROD ELECTRODES:

A. Install ground rods in the approximate location shown. Drive three, 10-feet sections into the earth such that the top of the uppermost rod is 8" below finished grade.

B. Install an enclosure for each ground rod, similar to a Quazite "PC" style, open bottom box, with nominal dimensions of 17" long x 11" wide x 12" deep. Box cover and installation method shall be suitable for full vehicular traffic (15,000 lbs over a 10" square). Box cover shall be locking type and have the logo "GROUND".

C. The rod and exothermic connection to the grounding electrode conductor shall be accessible from within enclosure. Fill the lower 2" of enclosure with crushed rocks. Top of enclosure shall be flush with finished grade.

D. Install boxes in accordance with the manufacturers' instructions for the loading indicated. Note that full vehicular traffic rating requires the box to be encased in concrete and use of steel cover.

3.3 BUILDING PERIMETER GROUNDING ELECTRODE:

A. Make bottom rebar in concrete footing around the perimeter of the building electrically continuous. Ensure minimum of 2" of concrete encasement between earth and rebar. Ensure that the concrete footing is in direct contact with the earth. Where vapor barrier, insulation, films, or similar items are below footer, paragraph B below shall be followed instead.

B. Ground Ring. Install a No 4/0 AWG bare copper conductor around the perimeter of the building, with at least 30" cover. Install conductor as close to foundation wall as possible.

3.4 UNDERGROUND METAL WATER PIPE ELECTRODE:

A. Make connection to “street” side of water meter.

B. Install braided type bonding jumper between “street” side and “house” side piping such that removal of water meter will not interrupt ground path.

C. The connection shall be accessible.

3.5 EQUIPMENT GROUNDING CONDUCTORS:

A. Install an equipment grounding conductor in all branch circuit and feeder raceways, sized in accordance with Article 250 of NFPA 70.

3.6 BONDING:

A. Bond the structural steel frame of the building to the service equipment ground bus. The connection shall be accessible.

B. Bond column anchor bolts of structural steel building to building perimeter grounding electrode no less than every 100’.

C. Multiple buildings present under one electric service shall be bonded.

D. Bond each dry type transformer to nearest accessible structural steel member if present. Otherwise to nearest metallic water pipe.

E. Bond interior metal piping systems to the service equipment ground bus. The connections shall be accessible.

F. Bond metallic equipment enclosures to a lug installed within the enclosure, which is connected to an equipment grounding conductor.

G. Bond standard device grounding terminals to metallic outlet box and to equipment grounding conductor.

H. Bond equipment grounding conductor to metallic boxes where splices are made.

3.7 SINGLE POINT GROUNDING FOR EQUIPMENT ROOMS REMOTE FROM THE SERVICE EQUIPMENT:

A. Extend a No 4/0 THWN grounding conductor from a convenient point along the “ground ring” to the each electrical room or other space where connection to a system grounding point

is required. In electrical rooms, this point shall serve as the point of connection to secondary of dry type transformers, grounding point for surge arresters, and the point of a supplementary connection to the building steel. Connection to ground ring does not have to be accessible.

B. Terminate the conductor on a 1/4" thick x 3" high x 12" long copper bar. Rigidly attach bar to the wall, providing a 2" gap between wall and bar. Drill bar and install lugs to make all necessary connections.

3.8 SINGLE POINT GROUNDING FOR MDF AND IDF ROOMS:

A. Extend a No. 2 THWN grounding conductor from a convenient point along the “ground ring” to each room. Connection to ground ring does not have to be accessible.

B. Install a 6-hole, 100A, ground bus at the bottom, center of each four foot backboard. Run the conductor along the bottom of the back boards, and connect to ground bars.

C. Bond all cable trays and relay racks to the initial ground bus, using a No 6 AWG conductor.

3.9 INTERCONNECTION OF SYSTEMS:

A. Extend a No. 4/0 THWN grounding conductor from a convenient point along the building perimeter grounding electrode to each Lightning Protection System ground rod.

3.10 BONDING BUSHINGS AND LOCKNUTS:

A. Bushings and locknuts shall be required:

1. Service entrance conduit stub-ups. Interconnect with No. **250 kcmil** (bare) and bond to ground bus in the service equipment.
2. When required by the NEC for voltages in excess of 250V. Bonding conductor shall be sized per the NEC.
3. When terminating conduits in concentric or eccentric knockouts. Bonding conductor shall be sized per the NEC.
4. For all connectors that are **not** U.L. listed as suitable for grounding.

B. Bushings shall be connected to the respective enclosure by an equipment grounding conductor sized in accordance with Article 250 of the NEC.

3.11 LABELING:

A. Provide a waterproof “CAUTION” tag at the point of connection to each grounding electrode, which reads: “ELECTRICAL SYSTEM GROUNDING ELECTRODE - DO NOT REMOVE THIS CONNECTION. NOTIFY BUILDING MANAGEMENT IF DAMAGED OR DISCONNECTED.”

B. Provide a “CAUTION” tag as specified above at the single point ground connection in MDF / IDF rooms and in all equipment rooms remote from the electrical service equipment.

C. Provide a “CAUTION” tag as specified above within the electrical service equipment where the grounding electrode conductor is terminated.

3.12 TESTING:

A. Upon completion of installation of electrical grounding system, test resistance of each ground rod installation using the "Fall of Potential" method. Ground resistance shall be measured in normally dry conditions not less than 48 hours after rainfall. Where tests show resistance to ground is over 25 ohms, take appropriate action to reduce resistance to 25 ohms or less by driving additional sections of ground rods and/or by chemically treating soil encircling ground rod; then retest to demonstrate compliance. Provide forms to record the data as the tests are conducted. Forms shall be signed by the person conducting the test.

END OF SECTION 26 20 80

SECTION 26 40 00 - ELECTRICAL SEISMIC CONTROL

PART 1 - GENERAL:

1.1 SCOPE OF WORK

A. Furnish all labor, materials, tools and equipment and perform all work necessary to complete the installation of the seismic control systems required by these specifications and as detailed on the drawings.

B. All foundations and supports required for the installation of Division 26 equipment shall be furnished by the Division 26 contractor unless specifically specified otherwise.

C. All concrete work, forming, framing, pouring and materials shall be furnished under Division 1 General Trades Portion of the contract documents.

1.2 RELATED DOCUMENTS

A. The drawings and general provisions of this division of the Contract, including the General and Special Conditions and Division 1 Specifications, apply to this Section.

B. Additionally, the following sections apply to this section:

1. Section 260100 – General Provisions - Electrical
2. Section 261010– Raceway Systems and Supports

1.3 QUALITY ASSURANCE

A. Codes & Standards: The installation of the Electrical systems shall be installed in accordance with the following codes and standards. All seismic restraint systems such as sway bracing, cable restraints, seismic restraints, etc. shall also meet the requirements as set forth in the following standards and codes:

1. The International Building Code (IBC)
2. National Electric Code, NFPA 70
3. SMACNA Seismic Restraint Manual
4. ASTM 488 Anchor locations
5. FEMA Standards

B. The seismic control equipment and products shall be sized and provided by one of the manufacturers listed below. The manufacturer shall have tested all seismic products provided for the specific intended use and installation.

C. The following list of manufacturers are acceptable manufacturers:

1. Kinetics Noise Control
2. Mason
3. Amber/Booth
4. Vibration Mountings and Controls

D. The manufacturer and/or his representative shall select all seismic control products in-accordance with these specifications and all applicable codes. All products shall provide the protection indicated based on the actual equipment weights and installation requirements of the approved equipment. The manufacturer shall provide installation instructions for all provided seismic restraints and bracing.

E. Submittals

The contractor shall submit for approval by the engineer, seismic anchorage requirements for all equipment and raceway systems. Anchorage calculations shall be prepared by a registered engineer and in the state where the project will be constructed. The engineer shall stamp calculations. Anchorage requirements shall be submitted for all base mounted equipment, suspended equipment, & roof mounted equipment. Seismic anchorage calculations shall include an "anchorage schedule" for the contractor's use. The anchorage schedule shall list the equipment, the size and quantity of fasteners and the minimum embedment depth of anchors. Calculations may be combined for similar types of equipment provided the size and weight does not vary more than 15% and the installation manner are similar.

PART 2 - PRODUCTS

2.1 GENERAL

A. All equipment shall be mounted or suspended from approved foundations and supports as specified herein.

B. All seismic control devices shall be listed for the intended use. It is the responsibility of the Contractor to determine the appropriate restraint methods with respect to the building type and the specific equipment used.

2.2 SEISMIC CONTROL:

A. The electrical systems serving the building shall be installed to meet the minimum requirements of the International Building Code regarding seismic protection and control. These specifications and the drawings indicate the minimum requirements and general intent. The actual requirements shall be determined by the seismic engineer and supplier and submitted for approval by the Electrical Engineer.

B. The seismic engineer shall be a registered engineer in the state in which the facility is constructed and whose principal area of practice is seismic engineering and related fields.

C. All equipment installed either floor or pad mounted, suspended from the structure or roof mounted on curbs shall be restrained and anchored unless exempt as hereinafter indicated.

D. The following criteria applies to this project (**VERIFY WITH STRUCTURAL)**:

1. The site classification will be: D
2. The Seismic Design Category will be: C
3. The Seismic Use Group will be: III
4. The Importance Factor for systems will be: 1 or 1.5

E. Where conduits, cable trays, or other electrical systems cross the seismic isolation interface between two seismically isolated structures, the systems shall have flexible connections to accommodate the seismic displacement of the two structures. Flexible connectors shall be installed on one side of the interface.

F. The following electrical components are exempt from seismic bracing or restraints:

1. Components in seismic design category A & B.
2. Components in Seismic Design Category C when the Ip = 1.0.
3. Electrical components in all Seismic Design Categories where Ip = 1.0, the equipment weight is less than 400 lb, the equipment is installed less than 4’-0” above the floor and flexible connections are installed between the equipment and associated conduit.
4. Electrical components located in Seismic Design Category D, E, & F that weigh less than 20 lbs and Ip = 1.0, and flexible connections are installed between the component and associated conduit.

G. Cable trays and electrical conduits located in Seismic Design Category D, E, & F shall be supported and seismically braced independently of the suspended ceilings.

H. Electrical equipment designated to have an Ip = 1.5 shall be designed and fabricated to withstand the horizontal forces as determined by the International Building Code, 2000 edition, paragraph 1621.1.4 and the manufacturer shall certify and provide certification that the equipment meets this requirement of the code.

I. All life safety systems and associated equipment and conduit installed in the building such as fire protection systems and smoke removal systems shall have an importance factor of 1.5. Systems having an importance factor of 1.5 shall be restrained.

J. All electrical equipment that is floor mounted and weighs 400 lbs or more shall be restrained.

K. All electrical equipment located in Seismic Design Category D, E, or F and installed 4’-0” or more able the floor and weighs more than 20 lbs shall be restrained. In addition, flexible connectors shall be provided between the equipment and connecting conduit.

L. Electrical components, equipment, and conduit containing hazardous or flammable material shall have an importance factor of 1.5 and shall be restrained.

M. Components and systems needed for continued operation of essential facilities (Category Use Group III) shall be restrained.

N. Anchorage of equipment to concrete floors and pads shall be in-accordance with the submitted anchorage calculations.

O. Connections of seismic restraint cable hardware shall be in-accordance with the submitted anchorage calculations.

PART 3 - EXECUTION

3.1 GENERAL:

A. If the equipment provided is not furnished with integral structural steel supports, mounting feet or lifting lugs, the contractor shall provide miscellaneous steel shapes as required to install or suspend the equipment and attach the seismic restraints as specified herein.

B. Support steel shall include but not be limited to rails, brackets, angles, channels, and similar components.

C. All seismic restraint products shall be installed as outlined in the manufacturer's printed installation instructions.

3.2 SEISMIC CERTIFICATE OF COMPLIANCE:

A. The manufacturer's representative shall be responsible for providing such assistance and supervision as necessary to assure a correct installation and adjustment of seismic control products.

B. The manufacturer's representative shall visit the installation once all installed items have been completed but prior to the installation of ceilings or walls that may conceal any devices and inspect the installation for compliance with the manufacturer's installation instructions. Upon satisfaction that all devices are installed correctly, the representative shall submit a written report outlining that the installation is in compliance with these specifications as well as the manufacturer's installation instructions.

END OF SECTION 26 40 00

SECTION 26 50 00 - LIGHTNING PROTECTION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SCOPE OF WORK:

A. The work required under this section of the specifications consists of the layout and installation of a functional and unobtrusive lightning protection system for the entire facility. All materials and devices which are an integral part of the lightning protection system shall be provided under this section of the Specifications.

B. Definitions: Terms as defined in NFPA 780 shall apply to this section.

1.3 RELATED WORK:

A. The electrical grounding system is specified in Section 262080.

B. Grounding of systems above 600V is specified in Section 263030.

1.4 QUALITY ASSURANCE:

A. The following standards are incorporated into and become a part of this specification by reference.
   1. National Electric Code (NFPA 70)

B. Lightning Protection Code (NFPA 780)

C. IEEE Std 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems
   1. Underwriters Laboratories, Inc.

1.5 LIGHTNING PROTECTION COMPONENTS:

A. 96A Installation Requirements for Lightning Protection Systems
   1. Lightning Protection Institute

B. LPI-175 Lightning Protection Installation Standard

C. LPI-176 Lightning Protection System Material and Component Standard

D. LPI-177 Inspection Guide for LPI Certified Systems

E. Acceptable Manufacturers: Firms regularly engaged in manufacture of lightning protection system components, of types, sizes, and ratings required, and who are Class I manufacturer - members of Lightning Protection Institute.

F. Installer's Qualifications - Firm with at least five years of successful installation experience with projects utilizing lightning protection system similar to that required for this project, and who are Class III, installer - members of Lightning Protection Institute.

G. Submittals:

1. Submit shop drawings to indicate information not fully described by the product data to indicate compliance with the contract drawings. Include layout indicating all system components and interconnection with each component identified for this project. Typical layouts are not acceptable. Prepare drawing at a minimum scale of 1/16"=1'-0".
2. Refer to Section 260120 for additional requirements.

H. U.L. Certification: Comply with UL 96A, "Master Labeled Lightning Protection Systems."

I. Coordination:

1. Review shop drawings submitted under this and other sections, as well as other divisions, to ensure coordination between work required among different trades. Coordinate the installation sequence with other Contractors to avoid conflicts and to provide the fastest overall installation schedule. Coordinate installation with architectural and structural features, equipment installed under other sections of the specifications and electrical equipment to insure access.
2. Provide a separate letter to the Roofing manufacturer requesting method of attaching materials to and penetrating roof, for each type roof. Engage the services of the roof installer to provide attaching materials and to make and seal all roof penetrations.

PART 2 - PRODUCTS

2.1 LIGHTNING PROTECTION SYSTEM COMPONENTS:

A. General: Provide lightning protection system material and components, of types, sizes, ratings, for Class 1 service, which comply with manufacturer's standard materials, design, and construction in accordance with published product information, and as required for complete installation. Materials and all components shall comply with NFPA 780 and LPI standards.

B. Materials
All lightning protection system materials shall be selected based on building materials present. Basis of design materials, unless inappropriate for building material, are as follows:

1. Air Terminals: solid aluminum.
2. Main Conductors: aluminum cable.
3. Secondary Conductors: aluminum cable.
4. Down Conductors: Copper cable. Use bimetallic connectors when transitioning from aluminum to copper cables.
5. Main Conductors Below Grade: copper cable.

C. Copper equipment shall not be connected to aluminum surfaces except by means of an LPI approved bi-metal transition fitting. Lead-coated fittings are not acceptable.

D. Ground rods shall be the type specified in Section 262080. All rods shall be accessible, (as defined in Section 262080) and shall be provided with a waterproof tag labeled "LIGHTNING PROTECTION SYSTEM".

PART 3 - EXECUTION

3.1 INSTALLATION OF LIGHTNING PROTECTION SYSTEMS:

A. Install lightning protection systems as indicated, in accordance with equipment manufacturer's written instructions, and in compliance with applicable requirements of NEC, NFPA 780 and LPI to ensure that lightning protection systems comply with requirements.

B. Coordinate with all trades as necessary, to interface installation of lightning protection system with other work.

C. Install conductors with direct paths from air terminals to ground connections avoiding sharp bends and narrow loops.

D. All roof conductors shall be concealed. Provide all necessary components for a concealed system installation.

3.2 DOWN CONDUCTORS:

A. Down conductors shall be installed in 1" schedule 40 PVC conduit. All down conductors shall be installed concealed.

3.3 INTERCONNECTION OF METALS:

A. Provide potential equalization and bonding of metal bodies as required by NFPA 780.

B. Bonding of all metallic objects and systems at roof levels and within the structures shall be complete. Bonds for metal bodies shall consist of, but not be limited to the following: Roof exhaust fans, HVAC units with related piping ductwork, exhaust vents and any other piping systems, antenna mast for TV, radio or microwave, flag poles, roof handrails and/or decorative screens, roof ladders, skylights, metal plumbing stacks, equipment yard fencing,

etc. Exterior architectural metal fascia and/or curtain walls or mullions, which extend the full height of the structure shall also be bonded, if not inherently bonded thru the building frame.

C. Other metal bodies shall be bonded as required by NFPA 780. Typical of these are: roof flashings, parapet coping caps, gravel guards, isolated metal building panels or siding, roof drains, down spouts, roof insulation vents and any other sizable miscellaneous metals, etc.

3.4 GROUNDING:

A. Grounding terminals (rods) shall be provided for each down conductor.
B. Bond all rods to building ground ring, if present.

3.5 BONDING:

A. Where LPS conductors are installed in metallic raceways, bond conductor to raceway at both ends.

3.6 TESTING:

A. Upon completion of installation of lightning protection system, test resistance-to-ground as specified in Section 262080.

B. Update shop drawings to reflect all field changes.

C. Test and certify the system per UL, NFPA and LPI requirements. Provide UL Master Label certification. Permanently affix label in a location approved by the Architect.

END OF SECTION 26 50 00

SECTION 26 60 11 - EMERGENCY POWER SYSTEM - NATURAL GAS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

B. Refer to Section 26 2042 and 26 2043 for information on the required selective coordination for emergency power system overcurrent devices. The coordination study is a requirement of NFPA 70 Articles 700 and 701.

1.2 SCOPE OF WORK:

A. The Emergency Power Systems shall provide alternate AC power source for designated loads in the event there is an interruption of normal utility power. When required, the units shall automatically transfer the full rated load from the normal power source to the standby emergency generator. Upon return of normal power, the loads shall be automatically transferred back to the normal power source and the emergency generator shall automatically shut off, after a cool down period.

B. The extent of Emergency Power Systems (EPS) work is indicated by drawings and by the requirements of this Section. Provide a complete automatically operated electric generating set of the size, type and operating characteristics described hereinafter, completely installed, tested and operative. All equipment, labor and materials necessary to accomplish this end shall be included, and the coordination of all required equipment and material shall be the responsibility of one manufacturer, who has an approved experience record in furnishing similar equipment.

1.3 QUALITY ASSURANCE:

A. Manufacturers: The following manufacturers are acceptable provided they meet all requirements of the specifications:

1. Onan/Cummings
2. MTU Onsite Energy (Detroit Diesel)
3. Generac
4. Caterpillar

B. Geographic Location:

1. The installation / service center shall be located within 75 miles.

C. Requirements:

1. The installation / service center shall be factory authorized and shall be certified, in writing, by the manufacturer, as being responsible for installation and warranty work and shall be capable of performing work on the engine, generator, battery charger, fuel system, automatic transfer switch and all accessories which make up the complete emergency power system.
2. The installation / service center shall provide on-site service within 4 hours of receipt of service request.
3. The installation / service center shall maintain adequate levels of repair parts inventory.

D. Compliance / Labels:

1. NFPA 110 service. Where a conflict between this document and NFPA 110 should arise, NFPA 110 shall govern.
2. Manufacturer Testing:
   a. Design prototype testing - Shall be performed on similar models of the unit furnished on this project.
   b. Final production testing of the engine/generator and automatic transfer switch - provide certified test reports.
   c. Field testing, by manufacturer's local representative.

1.4 SERVICE / MAINTENANCE AGREEMENT:

A. The *engine / generator supplier* shall provide a service / maintenance contract covering one year of operation, from the date of Substantial Completion. There shall be no deductible costs, or other costs, to the Owner for these services. All costs shall be included in the bid for this project. *The agreement shall be made in the name of the Owner*. The service / maintenance agreement applies to the following items of equipment:

1. Engine-Generator Set.
2. Automatic Transfer Switch.

B. The *Maintenance agreement* shall include the following and also shall include services per the equipment manufacturer's applicable instruction manual:

1. Lube, oil, and filter change
2. Fuel filter change
3. Engine tune-up with parts
4. Service/replace air cleaner
5. Check coolant level
6. Test anti-freeze and adj.
7. Inspect cooling system hoses
8. Service/replace belts as required
9. Check engine heater operation
10. Check generator set for fuel, oil, and coolant leaks
11. Check air intakes and outlets
12. Drain exhaust line
13. Inspect silencer
14. Check battery charger operation and charge rate

15. Check battery electrolyte levels and specific gravity
16. Emergency system operation with load applied for one hour period
17. Frequency check/governor adj.
18. Check transfer switch and accessory operation
19. Check engine alternator charge rate
20. Check engine-generator gauge and indicator operation
21. Check generator set controller operation including shutdown functions and emergency stop
22. Check generator output voltage and adjust as necessary

C. Maintenance shall be performed at intervals stated in equipment manufacturer's applicable instruction manuals except that the minimum service visits shall be four per year, and they shall be in Jan., Apr., July, and Oct.

D. Maintenance shall be performed near the middle of the month during the owners normal working hours. Arrangements will be made with the owner prior to each service call in order to secure access to the equipment.

E. The servicing agent will supply labor, supplies, parts and test equipment, as necessary to perform the service and preventative maintenance, at no additional cost.

F. *The service agreement* shall include labor, supplies and replacement parts to restore the system to operating condition, *whether due to normal wear and tear or defects in workmanship or materials.*

1. Response to *service* calls shall be made within 4 hours.

G. Owner will maintain a regular recommended service procedure as recommended by the servicing agent. A record of these maintenance procedures will be maintained for reference.

H. The servicing agent shall maintain a complete service history and necessary drawings and service procedure data for reference in service of the equipment. The agreement does not include any expense to repair damage caused by abuse, accident, theft, acts of a third person, forces of nature, alteration of equipment, or improper operation. The servicing agent shall maintain a representative stock of replacement parts for the complete emergency system and a competent factory-trained service organization.

I. After each inspection, the owner will be furnished a written report detailing any conditions found and advising further service required, if any, to assure operating dependability of the equipment under contract.

1.01 COMPREHENSIVE WARRANTY:

A. The standby electric generating system components, complete genset and instrumentation panel shall be warranted by the manufacturer against defective materials and factory workmanship for a period of five (5) years. Such defective parts shall be repaired or replaced at the manufacturer's option, free of charge for parts, labor and travel. The warranty period shall commence when the standby power system is first placed into service. Multiple warranties for individual components (engine, alternator, controls, etc.) will not be

acceptable. Satisfactory warranty documents must be provided. Also, in the judgment of the specifying authority, the manufacturer supplying the warranty for the complete system must have the necessary financial strength and technical expertise with all components supplied to provide adequate warranty support.

1.5 SUBMITTALS:

A. Refer to Section 26 0120 for requirements.

PART 2 - PRODUCTS

2.1 GENERAL:

A. The system shall have the following characteristics:

1. **625 KW / 781 KVA @ 0.8PF for Continuous Standby Service; based on use in outdoor housing - geographic location – Savannah, Georgia, USA. (K12 SCHOOL)**
2. **130 KW @ 0.8PF for Continuous Standby Service; based on use in outdoor housing - geographic location – Savannah, Georgia, USA. (FIELDHOUSE)**
3. **100 KW @ 0.8PF for Continuous Standby Service; based on use in outdoor housing - geographic location – Savannah, Georgia, USA. (MEDIA BUILDING)**
4. 3 phase, 4W, 480/277 Volts.
5. Provide monitoring and controls necessary to achieve the following sequence of operation:
   a. Transfer the emergency system load within the 10 second interval required by NFPA 110.
   b. After the emergency load has been stabilized, transfer the optional standby load. Time delay shall be field selectable, 1-5 minutes. Set for 1 minute.
   c. The emergency system loads shall take precedence over all other loads. An overload condition shall dump loads on the optional load standby system.

2.2 ENGINE:

A. Design: 8- cylinder, water cooled, naturally aspirated.
B. Bore: 5.31" Stroke: 6.50"
C. Piston displacement: 864.71 cubic inches.
D. Valves: per cylinder, single springs
E. Crankshaft: Forged steel, counterweight-type.
F. Connecting Rods: Forged steel with I-beam design.
G. Compression ratio: 9.5:1
H. Starting: 24V negative ground
I. Cylinder block: Cast Iron.
J. 40A battery charging alternator.

K. Fuel System: Fueled by natural gas and supplied with a unit-mounted electric solenoid fuel shut-off valve, flexible fuel line and secondary fuel pressure regulator.
L. Isochronous governor capable of +.25% steady-state frequency regulation.
M. Air Cleaner: Dry element with restriction indicator.
N. Lube Oil Capacity: 12 US Quarts, API CD 15W-40
O. Lube Oil Filter: Single spin-on, full flow.
P. Positive displacement, full pressure lubrication oil pump, cartridge oil filters, dipstick and oil drain.
Q. Cooling system: High ambient 122 deg F unit mounted radiator, blower fan, water pump and thermostat.

2.3 GENERATOR:

A. Salient-pole, brushless, 12 lead reconnectible type; self-ventilated, dripproof housing; amortisseur rotor windings and skewed for smooth voltage waveform. NEMA Class H insulation with fungus-resistant epoxy varnish.

B. Brushless excitation system controlled by solid-state, anti-tracking voltage regulator capable of maintaining +/- 2% for any constant load from 0 to 100% of rating. Provide individual adjustments for voltage range, stability and volts/hertz operations.

C. Voltage dip not to exceed 20% with one-second recovery within 2% of rated voltage, for one-step loads 0 to 90% of rating.

D. Shall sustain at least 250% rated current for minimum of 10 seconds, based on a 3-phase symmetrical fault.

E. Integral thermal-magnetic circuit breaker on output, coordinated not to trip under the conditions described above.

2.4 CONTROLLER:

A. Set-mounted, microprocessor-based, with vibration isolation. Modular construction to allow field replacement and for field testing without starting the generator. Controller shall include:

1. Fused DC circuit
2. Complete two-wire start/stop control which shall operate on closure of remote contact device(s).
3. Speed sensing and a second independent starter motor disengagement systems shall protect against starter engagement with a moving flywheel. Battery charging alternator voltage will not be acceptable for this purpose.
4. The starting system shall be designed for restarting in the event of a false engine start, by permitting the engine to completely stop and then re-engage the starter.
5. Cranking cycler with 15-second ON and OFF cranking periods. Crank control shall provide at least two cranking periods. Each cranking attempts shall be separated by appropriate rest periods. A sensing device shall automatically disconnect the starting circuit when the engine has started. If the engine has not started at completion of the starting program, the over cranking signal shall so indicated. The engine starting controls

shall be locked out and no further starting controls shall be locked out and no further starting attempts shall take place until the overcranking device has been manually reset. A selector switch shall be incorporated in the automatic engine start and stop controls. It shall include an "off" position that prevents manual or automatic starting of the engine; a "manual" or "handcrank" position that permits the engine to be started manually by the pushbutton on the control cabinet and an "automatic" position which readies the system for automatic start or stop on demand of the control system.

6. Overcrank protection designed to open the cranking circuit after 75 seconds if the engine fails to start.
7. Circuitry to shut down the engine when signal for high coolant temperature, low oil pressure, or overspeed are received.
8. Engine cooldown timer factory set a 5 minutes to permit unloaded running of the standby set after transfer of the load to normal.
9. Three-position (Automatic-OFF-TEST) selector switch. In the TEST position, the engine shall start and run regardless of the position of the remote starting contacts. In the Automatic position, the engine shall start when contact in the remote control circuit close and stop 5 minutes after this contacts open. In the OFF position, the engine shall not start even though the remote start contacts close. This position shall also provide for immediate shutdown in case of an emergency. Rest of any fault shall also be accomplished by putting the switch to OFF position.
10. Indicating lights to signal:
    a. Auxiliary Prealarm (Yellow)
    b. Auxiliary Safety Shutdown (Red)
    c. Switch “OFF” (Flashing Red)
    d. Overcrank (Red)
    e. Emergency Stop (Red)
    f. High Water Temperature (Red)
    g. Overspeed (Red)
    h. Low Oil Pressure (Red)
    i. Battery Charger Fault (Red)
    j. Low Battery Voltage (Red)
    k. Low Fuel (Red)
    l. System Ready (Green)
    m. Anti-High Water Temperature (Yellow)
    n. Anti-Low Oil Pressure (Yellow)
    o. Low Coolant Temperature (Red)
11. Test button for indicating lights.
12. Alarm Horn with silencer switch per NFPA 110.
13. Terminals shall be provided for each signal in 8.10 above, plus additional terminals for common fault and common prealarm.

2.5 INSTRUMENT PANEL:

A. The instrument panel shall include:

1. Dual range voltmeter 3-1/2 inch, 2% accuracy.
2. Dual range ammeter phase selector switch.
3. Voltmeter-ammeter phase selector switch.
4. Lights to indicate high or low meter scale.

5. Direct reading pointer-type frequency meter 3-1/2 inch, .5% accuracy, 45 to 65 Hz scale.
6. Panel illuminating lights.
7. Battery charging voltmeter.
8. Coolant temperature gauge.
9. Oil pressure gauge.
10. Running time meter.
11. Voltage adjust rheostat.

2.6 MOUNTING BASE:

A. The engine-generator shall be skid-mounted on two, iron “I” or “C” type channels. The design shall provide vibration isolation between the genset and the mounting base.

B. The frame design shall not inhibit easy access to the oil pan, after genset has been installed. Installations which require the use of a pump to drain the oil are not acceptable.

2.7 ACCESSORIES:

A. The following accessories shall be installed:

1. Block Heater, 120 Volt AC. Thermostatically controlled and sized to maintain engine coolant at 90°F (32°C) to meet the start-up requirements of NFPA 110, Level 1.
2. Generator strip heater, 120 volt, single phase for high humidity applications.
3. Over voltage protection will shut down the unit after one second of 15% or more overvoltage. Note: Sensitive equipment may suffer damage in less than one second of an overvoltage condition. On-line equipment requiring faster shutdown should have its own overvoltage protection.
4. Weather housing, constructed of rugged steel, cleaned, phosphated, and electrocoat painted inside and out with rust inhibiting primer and exterior coat of the manufacturer’s standard color. Provide hinged, double doors on each side to give easy access to the genset, and a rear door to allow access to the control panel. All door handles shall be key-lock type. Skid and floor design shall include a removable panel below the engine oil pan. All shelters shall come ready for job-installation. Top-mounted exhaust silencer with rain shield over the exhaust opening. Note: A 120 volt battery box heater shall be included.
5. Battery rack, battery cables, 12-volt batteries capable of delivering the required minimum cold-cranking amps required at 0°F.
6. 10-Ampere automatic float and equalize battery charger with +/- 1% constant voltage regulation from no load to full load over +/- 10% AC input line variation, current limited during engine cranking and short circuit conditions, temperature compensated for ambients from -40°C to +60°C, 5% accurate voltmeter and ammeter, fused, reverse polarity and transient protected. Provide alarm circuit board to meet the requirements of NFPA 110 for low battery voltage, high battery voltage, and battery charger malfunction.
7. Gas-proof, seamless, stainless steel, flexible exhaust connection, and engine exhaust silencer rated for critical application. Exhaust noise shall be limited to 85 dBA as measured at 10 feet in a free-field environment.
8. 16-Light remote annunciator shall monitor all controller functions described in Paragraph

2.04.A.10 of the controller section plus line power and generator power monitoring. An integral lamp test and horn silencer switch shall be included, as required to meet NFPA 110. [*Locate this annunciator adjacent to the fire alarm control panel*.] Provide all wiring between remote annunciator and generator set.

2.8 AUTOMATIC TRANSFER SWITCH:

A. The automatic transfer switch shall consist of a power transfer module and a control module, interconnected to provided complete automatic operation. Enclosure type shall be NEMA 1. The automatic transfer switch shall be mechanically held and electrically operated by a single solenoid mechanism energized from the source to which the load is to be transferred. The switch shall be rated for continuous duty and be inherently double throw. *The switch shall be open transition (break before make) and be mechanically interlocked to ensure only one of two possible positions - normal or emergency.* The automatic transfer switch shall be suitable for use with and supplied by the manufacturer of the standby generator to be furnished for this project. The switch shall be 4-pole, rated for use on a [208Y/120V] [480Y/277], 3-phase, 4-wire system. *Withstand rating shall be at least the same as the interrupting rating as the feeder breaker on the normal power input.* Basis of design: ASCO Series 300.

B. Automatic transfer switches utilizing components of molded-case circuit breakers, contactors, or parts thereof which have not been intended for continuous duty or repetitive load transfer switching are not acceptable.

C. All main contacts shall be of silver composition. The operating transfer time in either directions shall not exceed one-sixth (1/6) of a second.

D. The control module shall be supplied with a protective cover and be mounted separately from the transfer switch for ease of maintenance. The interconnecting wiring harness shall include a disconnect plug to disconnect all wires including both sources of control power for routine maintenance.

E. Sensing and control logic shall be solid-state and mounted on plug-in printed circuit boards. Printed circuit boards shall be keyed to prevent incorrect installation. Interfacing relays shall be industrial control grade plug-in type with dust covers.

F. All standard control features shall be contained in this control module and will be equal to ASCO Group G for 3 phase service. This group contains all of the following:

1. Voltage and Frequency Sensing
2. Time Delays
3. Engine Control Contacts
4. Test Switch
5. Indicators

G. Provide the following accessories:

1. Engine generator exercising timer with toggle switch to select load, no-load operation. Adjustable in 15 minute increments. Factory set at 20 minutes minimum each week unless otherwise specified.

2. Switched neutral transfer contact.

H. Inspection of all contacts (movable and stationary) shall be possible from the front of the switch without disassembly of operating linkages and without disconnections of power conductors. A manual operating handle shall be provided for maintenance purposes.

I. The automatic transfer switch shall conform to the requirements of NEMA Standard ICS2-447 and Underwriters Laboratories UL 1008.

J. The complete automatic transfer switch shall be tested as to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements. Submittals for approval shall include wiring diagrams, dimensional data, and complete description of operation.

K. The transfer switch shall be furnished with an operator's manual providing installation and operating instructions.

2.9 GENERATOR DOCKING STATION

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. TRYSTAR, or prior approved equal.

B. Docking station shall include 16 Series Camlok Panel Mounts for use as connection to Portable Generator.

C. Entire package must be listed to ETL or UL 1008 Standards. UL listing of individual components is not acceptable.

D. Enclosures:

1. NEMA 3R rain-tight, 304 GA aluminum enclosure
   a. Pad-lockable front door shall include a hinged access plate at the bottom for entry of cables from portable generator or portable load bank. NEMA 3R integrity shall be maintained with access plate open for cable entry.
   b. Front and side through a front access panel shall be accessible for maintenance.
   c. Top, side, and bottom through a front access panel shall be accessible for permanent cabling.
2. Finishes:
   a. Paint after fabrication. Powder coated Hammertone Gray.

E. Phase, Neutral, and Ground Buses:

1. Material: Silver-plated Copper
2. Equipment Ground Bus: bonded to box.
3. Isolated Ground Bus: insulated from box.
4. Ground Bus: 50% of phase size.
5. Neutral Bus: Neutral bus rated 100 percent of phase bus.

6. Round edges on bus.

F. Temporary generator connectors shall be Camlok style mounted on gland plate.

1. Camlok shall be color coded according to system voltage
   a. A phase – Brown
   b. B phase – Orange
   c. C phase – Yellow
   d. N Neutral – White
   e. G Ground – Green

G. Temporary connectors shall include protective flip lids to prevent accidental contact.

H. Permanent connectors shall be broad range set-screw type, located behind an aluminum barrier.

I. Short Circuit & Withstand Rating

1. Shall be minimum 65KAIC unless otherwise indicated on drawings.

J. Voltage & Amperage:

1. 480Y/277V for life safety branch. See drawings for amperage.
2. 480Y/277V for non-essential branch. See drawings for amperage.

K. Phase Rotation Monitor Device:

1. Phase monitoring relay to be Siemens 3U4512-1AR20 or equal.

L. Breaker Disconnect:

1. Must be UL 489 Listed Breaker
2. Breakers shall be removable for service and maintenance

M. Additional accessories shall be included in submittal drawings as follows:

1. Two Wire Auto Start
2. Battery Charger Receptacle 20A GFCI 125V
3. Block Heater Receptacle 30A L5-30 125V
4. Extra Depth for Bottom Conduit Access
5. Kirk Key Door Interlock
6. Listed Monitoring Device
7. Strip Heater & Thermostat
8. Surge Protection Device
9. Utility Light/Alarm

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install genset on concrete pad whose dimensions exceed the weatherproof housing by at least six inches, all sides. Pad thickness shall be 12". Concrete shall be 2500 psi , reinforced with 8 ga wire fabric. Anchor genset to concrete pad as recommended by the manufacturer.

B. Provide branch circuit wiring and necessary breakers for generator accessories.

C. Wall mount the automatic transfer switch where indicated.

D. Provide factory representative to conduct startup and testing. Testing shall comply with the requirements of NFPA 110, paragraph 5-13, "Installation Acceptance". Provide resistive load bank to conduct the tests.

E. Upon completion of testing, the factory representative shall provide 8-hours of on-site training of the Owner's designated personnel.

F. All wiring and interconnections shall be in accordance with commercial electrical standards. Installation drawings and complete wiring diagrams shall be furnished to the Owner.

END OF SECTION 26 60 11

SECTION 26 70 10 – PHOTOVOLTAIC SYSTEM

PART 1 GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

B. The Contractor shall comply with the general conditions of this specification for requirements for submittals, substitutions, testing, training, warranty, damage responsibility, permits, fees, clean-up, and all other general items, in addition to any specific requirements of this section.

C. Work shall comply with the requirements set forth by all applicable codes, standards, local authorities, utilities, and manufacturer's instructions/ recommendations.

D. The Electrical Contractor shall comply with the PV system construction document drawings, including all notes and specifications.

E. The Electrical Contractor shall examine the architectural and electrical drawings to determine related requirements.

F. All work, including equipment, materials, and installation shall conform to International Building Code (IBC), NFPA-70-National Electric Code.

G. The minimum requirement of the more stringent code or standard shall govern where more than one code or standard is applicable to any component or condition.

1.2 DESCRIPTION:

A. *This is a performance-based specification*. The system specified herein shall be designed by the manufacturer or an authorized representative of the manufacturer. The system shall be designed and installed in accordance with recommendations and requirements of the standards listed below.

B. This section consists of a 30kW solar laminate PV system and associated supports designed for roof installation. The Electrical Components of the System and wiring by Electrical Subcontractor are included herein.

C. The PV system described in this document shall be of the grid-connected type and shall not include battery/backup storage or secondary electrical generation devices. PV system shall feed AC power into the local services when solar energy is available and shall immediately disconnect from the grid upon loss of grid power to the service as per IEEE and local utility regulations.

D. PV system shall comply with these specifications, all applicable construction document drawings, all applicable codes, and all local authorities having jurisdiction. System shall comply with all policies and standards required by the electrical utility having jurisdiction and all applicable incentive program guidelines. Inverters, disconnects, combiners, wire, conduit, junction boxes, mounting hardware, monitoring equipment, and other electrical balance of systems components are provided by the Electrical Contractor.

E. Electrical Contractor shall provide access to equipment for maintenance and services as required by the manufacturer's instructions and/or applicable codes.

F. The PV system installer shall coordinate with the Architect on locations and appearance of all PV modules and cable tray(s). All locations must be approved by the Architect prior to installation.

G. The Electrical Contractors shall coordinate with the Architect and Electrical Engineer on locations and appearance of all exposed equipment, including but not limited to conduit, inverters, disconnects, wire ways, and control and monitoring equipment. All locations must be approved by the Architect and Electrical Engineer prior to installation.

H. The Electrical Contractor shall be responsible for electrical tie in of the PV System to the respective panelboards indicated on the drawings.

1.3 STANDARDS:

A. 2017 National Electric Code (NEC)
1. Article 690—Solar Photovoltaic Systems.
2. Article 250—Grounding.
3. Article 110—Requirements for Electrical Installations.

B. IEEE Standards
1. IEEE 1262—PV Module Qualification for Performance and Reliability.
2. IEEE 929—Inverter Interconnection Standard.

C. Underwriters Laboratories (UL) Standards
1. UL1703—Flat Plate PV Modules and Panels.
2. UL1741—Standard for Static Inverters and Charge Controllers for Use in Photovoltaic Power Systems.

D. National Fire Protection Association Standards

E. OSHA Standards
1. 1926 Subpart M—Fall Protection

1.4 UTILITY APPROVAL:

A. Electrical Contractor shall provide all paperwork, coordination, and administration services required for local utility interconnection approval.

1.5 CONTRACTOR QUALIFICATIONS:

A. PV systems shall be installed by an NABCEP certified installer approved by the PV system manufacturer. Installer shall have proof of experience with the installation of two commercial solar photovoltaic roof mounted systems, each in excess of 30 kW within the past three years.

B. The PV system described herein shall be wired by a licensed electrical contractor.

1.6 WARRANTY:

A. The PV system manufacturer warrants that the PV system shall:
   1. During the first ten (10) years from the date of sale, produce at least 92% of the minimum power output rating.
   2. During the first twenty (20) years from the date of sale, produce at least 84% of the minimum power output rating.
   3. During twenty-five (25) years from the date of sale, produce at least 80% of the minimum power output rating, where the minimum power output rating is the rated power minus the applicable tolerance, as specified in the PV Product technical data sheet.

PART 2 – PRODUCTS

2.1 GENERAL:

A. All materials, fixtures, and equipment required for the work shall be new, of first-class quality, and shall be furnished, delivered, erected, connected and finished in every detail, and shall be selected and arranged as to fit properly into the building spaces. Where no specific kind or quality of material is given, a first-class standard article as approved by the Construction Manager shall be furnished.

B. All equipment shall be listed and labeled per recognized electrical testing laboratory and installed per the listing requirements and the manufacturer’s instructions.

C. All equipment shall be approved for use by the electric utility having jurisdiction and any applicable incentive programs.

D. All equipment shall be properly grounded per the requirements of the National Electric Code, Article 250.

E. All outdoor equipment shall be minimum NEMA 3R.

F. Provide equipment as specified on the drawings, or approved equipment of equal quality and performance. Provide all accessories needed for a complete, secure, operational grid-tied PV system.

G. Conduit specification shall comply with, NEC & Division 26 Electrical requirements.

2.2 PV MODULES:

A. PV modules shall be by a manufacturer listed on the electrical drawings or prior approved equal.

2.3 INVERTERS:

A. Inverters shall be by a manufacturer listed on the electrical drawings or prior approved equal.

2.4 OTHER SYSTEM COMPONENTS:

A. All other PV system components (combiner boxes, DC disconnects, roof supports, etc…) shall be as recommended and certified by the PV system manufacturer.

PART 3 – EXECUTION

3.1 GENERAL:

A. All electrical work shall be in accordance with the 2017 National Electric Code.

B. All circuits connected to more than one source shall have over-current devices located to provide over-current protection from all sources per NEC Article 690.9(a).

C. Cut no structural members. If equipment cannot be properly concealed, notify Construction Manager.

D. Attachments: Support all work adequately and per code.

E. Shoring: The Contractor shall provide all permanent and temporary shoring, anchoring and bracing required by the nature of this work in order to make all parts absolutely stable and rigid, even when such shoring, anchoring and bracing are not explicitly called for.

F. Contractor shall keep work areas in a clean and safe condition. Remove all equipment, tools, vehicles, rubbish, waste and debris from the site upon completion of the job. The Contractor shall pay all fees for recycling and disposal.

G. All DC conductors shall be sized such that there is a maximum of 1.5% voltage drop measured at the short circuit current rating of that circuit over the entire length of each circuit from PV module to inverter and back to PV module. All AC conductors shall be sized for maximum of 1.5% voltage rise measured at the continuous AC current rating of the inverter between the inverter and the point of interconnection with the grid.

H. Each series string of PV modules shall be independently protected by an isolation fuse or breaker before it is connected in parallel with the other string on that PV output circuit. The current rating of this isolation fuse or breaker shall be less than the de-rated ampacity of the wiring that it is protecting and greater than 1.56 times the short circuit current rating of the PV modules in that PV source circuit. All other conductors and overcurrent devices shall be sized per the requirements of National Electric Code (NEC) Article 690.8.

3.2 POWER MAXIMIZATION:

A. Locations of PV panels are indicated on the electrical drawings. Architect shall approve where PV Panels are located, in regard to minimizing shading, at Shop Drawing time and prior to installation for maximum power production.

3.3 COMMISSIONING:

A. Electrical Contractor shall provide final and complete commissioning of the PV system.

B. PV system installer shall verify that all PV panels, ballasted roof mounting structures, and cable tray(s) are installed according to the requirements of the PV drawings, specifications, and manufacturer's written instructions.

C. Electrical Contractor shall verify that all Electrical components are installed and connected according to the requirements of the PV electrical drawings, specifications, and manufacturer's written instructions.

D. Before starting or operating the system, Electrical Contractor shall check continuity of all conductors and grounding conductors to verify that there are no faults and that all equipment has been properly installed. Check factory instructions to see that installations have been made accordingly. Check equipment for any damage that may have occurred during shipment, after delivery, or during installation. Replace damaged equipment.

E. Before starting or operating the system, Electrical Contractor shall obtain a final inspection approval and final inspection from local utility. Electrical Contractor shall be present on site for both inspections.

F. PV system installer shall test all equipment to ensure specified capacity and performance of the system. The PV system installer shall notify the Construction Manager a minimum of 5 days prior to the test so that an Owner's representative may witness the test. Electrical Contractor shall replace any electrical equipment or work found deficient during the test. PV system installer shall replace any non-working PV panels or other PV system equipment found deficient during the test.

G. PV Module Test: During the daytime while the sun is shining on the PV array, measure the short circuit current and open circuit voltage of each string (in isolation from other parallel strings) and verify that the output is consistent with PV module manufacturer's specifications.

H. PV installer shall make final adjustments to all inverters and monitoring equipment so that they will be placed in an acceptable operating condition. Adjustable parameters shall be set so that the PV system will produce the minimum possible amount of energy on an annual basis.

I. Replace all damaged and/or malfunctioning equipment.

END OF SECTION 26 70 10

SECTION 27 01 00 - GENERAL PROVISIONS - COMMUNICATIONS AND ALARM SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 IMPOSED REGULATIONS:

A. Applicable provisions of the State and Local Codes and of the following codes and standards are hereby imposed on a general basis for electrical work:

1. NEC, National Electrical Code (NFPA No. 70), with Georgia Amendments.
2. The Life Safety Code (NFPA No. 101), with Georgia Amendments.
3. State of Georgia ADA Accessibility Guidelines for Building and Facilities.
4. The International Building Code, with Georgia Amendments.
5. EIA/TIA Telecommunications Standards.
6. The National Fire Alarm Code (NFPA 72), with Georgia Amendments.
7. U.L. Fire Resistance Directory.
8. U.L. Electrical Construction Materials Directory.
9. U.L. Electrical Appliance and Utilization Equipment Directory.

1.3 DESCRIPTION OF WORK:

A. Provide all labor, materials, equipment and supervision to construct complete and operable communication and alarm systems as indicated on the drawings and specified herein. All materials and equipment used shall be new, undamaged and free from any defects.

B. Outlet boxes, raceway systems, cable trays, sleeves and line voltage power connections for Division 27 systems shall be provided under Division 26.

1.4 COORDINATION:

A. Coordinate work provided under this division of the specifications with work provided under other divisions of the specifications and work provided by the Using Agency, where applicable.

1.5 PROJECT STAFFING:

A. Superintendent:

1. Provide a superintendent to plan, layout, supervise and coordinate the work by all organizations providing work under Division 27. The superintendent shall be at the job site at all times work is being performed.
2. The superintendent shall have a minimum of 5 years experience in educational projects of

similar size and scope. The Superintendent shall have a State of Georgia Unrestricted Low Voltage License (LV-U).

B. Organizations Furnishing and Installing Division 27 Systems:

1. Division 27 systems are specified by the name of acceptable manufacturers. Each of the systems shall be furnished and installed by an organization that:

   a. is an authorized and certified representative of the manufacturer, for purchase, installation and service of the specific system.
   b. has current State of Georgia low voltage license appropriate for the system(s) being installed.
   c. stocks replacement parts for the specific system.
   d. has systems technicians in their employ
   e. has cable installers in their employ
   f. has experience on projects of similar size and scope.
   g. has been in business for at least 3 years.
   h. can respond to emergency service calls within 4 hours, and routine service calls within 24 hours.

C. Systems Technicians:

1. The devices and equipment that make up each of the systems included in Division 27 shall be installed, started (where applicable) and tested by technicians in the employment of the organization furnishing the system. Technicians shall have at least one of the following:

   a. NICET Level II Engineering Technician Certificate AND manufacturer authorized training, for the specific system to be installed.
   b. State of Georgia LV-A, LV-T or LV-U license AND manufacturer authorized training, for the specific system to be installed.

D. Cable Installers:

1. Cabling systems, including devices and terminations, for each of the systems included in Division 27, shall be installed, and tested by technicians in the employment of the organization furnishing the system. Technicians shall have State of Georgia LV-G license AND manufacturer authorized training, for the specific system to be installed.

E. Helpers:

1. Persons who do not possess the qualifications described herein shall be considered helpers. Helpers may assist technicians or cable installers, but shall not be allowed to install devices, make equipment connections or perform other work for which they are not qualified.
2. Helpers shall not perform any work on the project, at any time, without supervision by the Technician.

F. Submit resumes for organizations, systems technicians and cable installers for review and

approval by the Architect, prior to proceeding with any work on the project.

1.6 UTILITY CONNECTIONS:

A. The approximate point of origination for electric, telephone, fiber optic and television utilities is shown on the drawings. Confirm the location with the respective utility prior to ordering materials or beginning any trenching. The Contractor's bid shall allow for the service point to be shifted by the utility 50' feet in any direction from that shown.

1.7 DIVISION 27 DRAWINGS:

A. Do not scale the drawings. Obtain all dimensions from the Architect's dimensioned drawings, field measurements and shop drawings.

B. Drawings are diagrammatic and indicate the general arrangement and connection of equipment and devices. The contractor shall review product data sheets, wiring diagrams, manufacturer's installation instructions, etc. and provide the connections required to place equipment into service.

C. Discrepancies shown on different drawings, between drawings and specifications or between documents and field conditions shall be brought to the attention of the Architect.

1.8 PERFORMANCE TESTING:

A. The performance testing specified in Section 272010 shall be performed by a testing agency selected and paid for by the Owner.

1. The contractor shall provide personnel, tools and equipment necessary to make all work accessible to the testing agency.
2. A copy of the test reports will be made available to the contractor. Where the test results indicate that the system or portions of the system do not meet specified performance levels, the contractor shall investigate, identify and correct those deficiencies. Upon written notification by the Contractor that deficiencies have been corrected, the Architect will schedule re-testing to the extent deemed necessary by the Testing Agency. The Contractor shall bear the cost of re-testing.

B. Testing specified in other sections shall be performed by authorized representatives of the system manufacturer, scheduled and paid for by the Contractor.

1. The contractor shall provide personnel, tools and equipment necessary to conduct the tests.
2. Provide three copies of all test results. For each system, include a cover page with the Testing Agency letterhead, name of persons conducting the test, date(s) of tests, and an executive summary of the testing performed. Include the detailed results after this summary.

C. Notify the Architect, in writing, 48 hours in advance of any testing to be performed. Include the system, or systems to be tested. The purpose of this requirement is to allow the Architect

and Using Agency time to schedule representatives to be present.

1.9 RECORD DOCUMENTS:

A. The superintendent shall maintain a white set (blue-line or black-line) of contract documents in clean, undamaged condition, for mark-up of actual installations which vary substantially from the work as shown. Mark-up whatever drawings are most capable of showing installed conditions accurately. These documents shall be used for no other purpose. As a minimum, record the following:

1. Post all addenda prior to beginning work.
2. Post all changes in the work.
3. Scope of each change order (C.O.), noting C.O. number.

1.10 RECORD MANUALS:

A. Manufacturer's operation and maintenance manuals for each Division 27 system.

B. Shop drawings, revised to reflect all review comments, *supplemented with the installation instructions shipped with equipment.*

C. As-built copy of the master cabling plan in AutoCad 2012 format, on CD rom.

D. As-built copy of the system specific drawings in AutoCad 2012 format, on CD rom.

1.11 Submit record manuals in quantities and in the format prescribed in the Division 1 specifications, plus one copy for the Engineer.

1.12 TRAINING OF OWNERS FORCES:

A. Train Owner's personnel on the operation and maintenance of the following systems:

1. Fire Alarm System - 4 hours
2. Intercom System - 4 hours
3. Voice Reinforcement systems - 4 hours
4. Intrusion Detection System - 4 hours
5. Tour of Facility - 8 hours

B. The "tour of facility" shall consist of a walk-thru of the entire facility. Demonstrate the operation of all devices, equipment and systems.

C. *Training shall not be conducted until the final inspection of the work has been conducted by the Architect and all punch list items completed.*

D. As a minimum, the following materials shall be reviewed during the training session:

1. Owner's operation and maintenance manual.
2. Corrected shop drawings and as-built system drawings.

3. Hands-on demonstration of system features and operation.

E. Notify the Architect, in writing, 10 working days in advance of each training session. Include a detailed agenda for the system. No more than two systems shall be covered in one day. The purpose of this requirement is to allow the Architect and Using Agency time to schedule representatives to be present, and is subject to the approval of the Architect.

F. Training shall be conducted at the project site by authorized representatives of the system manufacturer and the Division 27 superintendent.

G. Each training session shall be recorded using digital video recorder, saved on a CD rom. Disks shall be delivered to Owner with Record Manuals.

1.13 REVIEW OF THE WORK BY THE ARCHITECT:

A. During the course of the project, the work will be reviewed by a representative of the Architect. Upon each visit, demonstrate that the record documents and shop drawing files are being kept current.

B. The Superintendent shall accompany the Architect on all reviews and shall provide all personnel, tools, ladders, etc. necessary to conduct the review.

C. Prior to reviewing of work in progress, or at the final inspection, the Contractor shall submit a letter describing the specific work to be reviewed, along with a punch-list of items that are incomplete or which require correction, based on observations made by the supervisor of the given trade. Reviews will not be scheduled until this information is submitted. The Contractor shall bear the burden of any resulting delays.

D. Construction review reports will be issued by the Architect for every review trip. Within five working days from the date of review, the Contractor shall submit a letter which addresses when corrections will be made for each deficiency in the report. Prior to subsequent review of the work, the Contractor shall submit a letter confirming that the work required by all comments on the report have been completed.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Refer to the drawings and individual specification sections for requirements.

B. All equipment shall be suitable for the environment in which it is installed. Such considerations shall include, but not be limited to characteristics of this specific project such as wet/damp/dry locations, ambient temperature / humidity, spaces used as air plenums and hazardous locations. It shall be the responsibility of the contractor to review the contract documents and order equipment based on intended use.

2.2 MATERIALS:

A. All materials and equipment used shall be new, undamaged and free from any defects.

B. Provide materials and equipment that are U.L. listed, unless listing is unavailable.

C. All equipment of the same type or of the same product category shall be the product of a single manufacturer.

D. Where product is specified by catalog number, such specification is intended only to convey general characteristics. Actual product selection shall be based on catalog number, other references on the drawings / specifications and intended use.

2.3 ACCEPTABLE MANUFACTURERS:

A. Provide equipment and materials which are products of the manufacturers listed on the drawings and in the specifications. Requests for substitution of other manufacturers shall comply with Division 1 and the paragraph “B” below.

B. Requests for prior approval (i.e. before the bid opening) must contain all information listed for the specific item in Section 270120, including any applicable dimensioned layout drawings. Requests must be sent by mail or express delivery such that they are received in the Architect’s office no later than ten working days prior to the opening of bids. Requests that are incomplete or are sent by facsimile will not be reviewed.

2.4 SPECIAL REQUIREMENTS:

A. All software-based electronic equipment shall use the manufacturer’s current software version as of the project bid date.

PART 3 – EXECUTION

3.1 ROLE OF THE SUPERINTENDENT:

A. The Division 27 Superintendent’s duties shall include, but not be limited to the following:

1. Preparation of submittals.
2. Planning and layout of the work.
3. Coordination with other trades and the local utility companies.
4. Posting addenda and changes in the work to maintain the Record Drawings and to ensure that Division 27 personnel are working from up-to-date drawings and specifications.
5. Supervision of all Division 27 personnel.
6. Ongoing review of work in place to ensure compliance with the Contract Documents.
7. Conducting a review of the work in place and materials stored for the Architect’s representative.
8. Administrative duties as required to fulfill the requirements of the General Conditions, Special Conditions and Division 1 specifications.

9. Training of the Owner's Forces.

3.2 PROTECTION OF THE WORK:

A. Protect the work during the course of construction. Do not install any equipment or materials until the proper environmental conditions have been established.

B. Store materials in the manner recommended by the manufacturer until materials are installed. Materials rated for indoor use shall not be stored outdoors regardless of the packaging in which the materials are shipped.

C. Do not install cables until the building is dried-in. For the purposes of this specification "dried in" shall mean the roof has been installed, all exterior openings are covered and the interior of the building is dry. Tape ends of all conductors to protect from damage. Coil cables and hang from the building structure. Use care not to exceed cable bending radius. *Under no circumstances shall cables be paid out on the floor.*

D. *Protect equipment and cables from being painted. Any equipment or cables that are painted shall be removed and replaced with new. Cleaning of paint from item is not an acceptable substitute.*

E. *Do not install devices, or equipment until spaces are broom clean and the building is conditioned.*

F. Install temporary protective covers over equipment enclosures, devices and similar items after interiors, conductors, devices, etc. are installed to protect the installation during finish work performed by others.

G. Clean all equipment, inside and out, upon completion of the work. Scratched or marred surfaces shall be touched-up with touch-up paint furnished by the equipment manufacturer.

H. Equipment or materials that are improperly stored or are installed before the proper environmental conditions are achieved will be removed and replaced with new, at no cost to the Owner. The Contractor shall bear all consequences from any resulting delays.

I. All equipment and materials that become damaged will be removed and replaced with new, at no additional cost to the Owner.

3.3 INTERFACE OF WORK WITH OTHER TRADES:

A. Where Division 27 work must adjoin, abut or be incorporated into work installed by other trades, engage the services of the other trade to interface the work. Under no circumstances shall the installer performing work under this Division of the specifications modify or alter work installed by others. Such work includes, but is not limited to:

1. Roof Penetrations.
2. Any attachments to roofing system.
3. Penetrations in Vapor Barriers.

4. Exterior Insulation and Finish Systems (EIFS).

END OF SECTION 27 01 00

SECTION 27 01 20 - COMMUNICATIONS AND ALARM SYSTEMS SUBMITTALS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 GENERAL:

A. Submit for review by the Architect, a schedule with engineering data of materials and equipment to be incorporated in the work.

1. Submittals shall be supported by descriptive materials, i.e., catalog sheets, product data sheets, diagrams, performance curves and charts published by the manufacturer, to show conformance to Specifications and Plan requirements; model numbers alone shall not be acceptable.
2. Data submitted for review shall contain all information to indicate compliance with Contract Documents. Complete characteristics shall be provided for all equipment.
3. The Architect reserves the rights to require samples of any equipment to be submitted for review.

B. *For each product group and type, provide a letter from the product manufacturer stating requirements for storing and handling at the job site prior to installing the product. The manufacturer shall specifically address acceptable temperature and relative humidity levels.*

C. All submittals shall be prepared by the organization furnishing the system. Submittals shall be checked for compliance by the Division 27 superintendent prior to submission.

1.3 RESPONSE TO SUBMITTALS:

A. Each item reviewed by the Architect will be marked with numerical review codes that correspond to the following:

1. "No Exceptions Taken": No corrections, no marks. Items may be ordered.
2. "Make Corrections Noted": A few minor corrections. Items may be ordered as marked up without further resubmission.
3. "Revise and Resubmit": Minor correction. Item may be ordered at the Contractor's option. Contractor shall resubmit drawings with corrections noted.
4. "Rejected": Major corrections or not in accordance with the contract documents. No items shall be ordered. Contractor shall correct and resubmit drawings.

B. Whether resubmittals are required or not, all shop drawings shall be corrected for the record manuals specified in Section 270100.

1.4 FORMAT:

A. Submittals shall be made by specification section. Submittal data shall be placed in one or more hard-back 3-ring binders, arranged and labeled according to specification section.
   1. Each binder shall contain a title page and table of contents. Provide separator tabs, and label by specification section. Make note in the table of contents, any drawings that accompany the submittal.
   2. Title page shall contain Project Name, Contractor's Name, Division 27 Superintendent's name, Suppliers and point of contact for each, and date.

1.5 SUBMITTAL GROUPING:

A. Submittals shall be made in the following groupings:

   1. Group 1
      a. Resumes and affidavits – 270100, 270120.
   2. Group 2
      a. Master cabling plan – 270120.
      b. Supports – 279010.
   3. Group 3
      a. Intercom System – 274010.
      b. Voice Reinforcement Systems – 2704032, 274040.
   4. Group 4
      a. Fire Alarm System – 271010.
      b. Intrusion Detection System – 275010.

B. System specific drawings shall be submitted with the respective specification section.

C. Submittals that do not comply with these requirements or that are deemed by the Architect to be incorrect or incomplete shall be returned without review. The Contractor shall bear the burden of any resulting delays.

D. Resubmittals must be scheduled two weeks in advance with the Architect. Resubmittals must be accompanied by a letter from the Contractor, with a copy of the previous submittal report, stating the resubmittal has incorporated all comments made on the previous report. Resubmittals made without this information shall be returned without review. The Contractor shall bear the burden of any resulting delays.

1.6 TESTING / TRAINING SCHEDULES AND TEST RESULT SUBMITTALS:

A. Submittals shall be made for each occurrence. Each submittal shall include a cover letter with the Contractor's letterhead.

1.7 EQUIPMENT AND MATERIALS REQUIRING SUBMITTALS:

A. Section 270100 - General Provisions - Communications and Alarm Systems

   1. Superintendent's qualifications

2. Installers' qualifications (as applicable for each system)

B. Section 270120 - Communications and Alarm Systems Submittals

1. Master Cabling Plan
2. System specific rough-in details
3. Attachment 1

C. Section 271010 - Intelligent Fire Alarm System

1. Draft copy of NFPA 72 Certification
2. Proof of Coordination with other trades.
3. Fire Alarm Control Panel
4. Voice evacuation system
5. Remote annunciator / Remote trouble station
6. Power Supplies
7. Batteries
8. Calculations - Power Supply, Battery Sizing, and Wire Sizing
9. Voice Alarm Control Panel
10. Pull Stations
11. Audible and audible/visible signaling devices
12. Door Holders
13. Monitor and control modules
14. Detectors and detector bases / housings
15. Cables
16. System specific drawings, per 270120, 3.04.B, plus interlock diagrams which shall include, as a minimum:
    a. Air handler shutdown.
    b. Interconnections to the electronic card entry / access system.
    c. Elevator recall and emergency shutdown.

D. Section 272011 - Cable Plant Labeling

1. Product data sheets for each type label.

E. Section 273000 – Area of Refuge Assistance System

F. Section 274010 - Intercom System

1. Headend components
2. Call Switches
3. Staff Stations
4. Administrative Stations
5. Ceiling speakers, back boxes, supports and grilles
6. Wall mounted weather-proof speakers and enclosures
7. Hardware for VOIP system interface.
8. Cables
9. System specific drawings

10. Line voltage surge arresters
11. Low voltage surge arresters
12. Remote terminal blocks

G. Section 274032 – Gymnasium Voice Reinforcement System

1. Wall mounted amplifier and accessory modules
2. Microphones and stands
3. Speakers and accessories
4. Cables
5. System specific drawings. , per 270120, 3.04.B

H. Section 274040 – Cafeteria Voice Reinforcement System

1. Wall mounted amplifier and accessory modules
2. Microphones and stands
3. Speakers and accessories
4. Cables
5. System specific drawings. , per 270120, 3.04.B

I. Section 275010 - Intrusion Detection System

1. Control Panel
2. Digital Communicator
3. Keypads
4. Detectors
5. Door Switches
6. Cables
7. System specific drawings, per 270120, 3.04.B

J. Section 279010

1. Bridle rings.
2. Cable ties.

PART 2 – PRODUCTS

Not Applicable.

PART 3 – EXECUTION

3.1 MANUFACTURER’S DATA:

A. For each system component, include the manufacturer's comprehensive product data sheet

and installation instructions. Where operating ranges are shown, mark data to show portion of range required for project application.

B. Provide manufacturer's product data sheet for each type of cable used. Include cross-section diagram of the cable assembly.

3.2 CALCULATIONS:

A. Provide calculations to substantiate the sizing of power supplies, transformers, backup batteries and similar items.

3.3 TEST REPORTS:

A. Submit test reports which have been signed and dated by the firm performing the tests, and prepare in the manner specified in the standard or regulation governing the tests procedure as indicated.

3.4 LAYOUT AND COORDINATION DRAWINGS:

A. MASTER CABLING PLAN:

1. Provide a master cabling plan that defines the pathways (horizontal and vertical) to be used for all cabling systems installed as part of this project. The approved pathways shall become the basis of the individual system cabling plans. The master cabling plan shall include the following:
   a. Pathways for backbone cable runs between the MDF and IDF locations.
   b. Pathways for workstation outlets.
   c. Pathways for specific system horizontal cables.
   d. Location, quantity and size of all sleeves through walls and floors, including the U.L. listed thru-penetration firestop system specifications for each type penetration.
   e. Location of bridle rings for all horizontal wiring.
2. The master cabling plan shall be prepared in accordance with all of the Division 27 specifications, EIA/TIA standards and the BICSI Telecommunications Distribution Methods Manual. The master cabling plan shall be developed and sealed by a designer with the Bicsi RCDD registration for telecommunications systems cabling design.

B. System specific drawings - Include the following:

1. Floor plans:
   a. Show all system equipment, devices and interconnecting cabling. Cabling shall be consistent with the master cabling plan. Provide a legend to define all devices and cable runs.
   b. Show labels for each device and cable run. For addressable systems, show the point ID for each device.
2. Details:
   a. Show the rough-in requirements and mounting height for every component. Include all requirements such as outlet box size/trim/alignment and raceway requirements.
   b. Prepare in sufficient detail such that these drawings can be used to provide the

required rough-in.

3. Point-to-point installation wiring diagrams of the entire system:
   a. Provide terminal diagram for every control panel, patch panels, interconnect center, etc.
   b. Provide wiring diagram for every device. Key these diagrams to the system diagrams.
   c. Provide wiring diagram depicting all interlocks of specific systems with other systems.
   d. Spare and unused terminals shall be marked as such. Indicate the size, type and color code of all conductors.
   e. The use of generic wiring diagrams is not acceptable. Wiring diagrams shall be prepared for this specific project.
4. Elevations:
   a. Provide an elevation drawing of the headend equipment / control panel / backboard, showing the location of all components.
   b. Indicate enclosure sizes and space available for future expansion.
   c. Backboard elevations shall show the layout of the various systems components installed thereon.

C. System specific drawings are required for each Division 27 system.

D. Drawing Format :
1. Drawings shall be prepared at the following scales:
   a. Floor plans: 1/16" = 1' - 0".
   b. Details: Not to scale.
   c. Wiring Diagrams: Not to scale.
   d. Elevations: ½" = 1' - 0".
2. Drawings shall be titled to define Project Name, Drawing subject, date prepared and designer's name and seal. All revisions shall be marked and dated.
3. Floor plan drawings shall include all room names and numbers.
4. CAD-generated drawings are required. Upon written request, an email with a zip file attachment containing the building floor plan(s) can be furnished to the contractor. The file will be in AutoCAD 2004 format. By requesting these drawings, the contractor agrees to accept them "as is". It will be the responsibility of the contractor to verify the drawings for accuracy and to make all changes necessary, at no additional cost to the Owner.
5. Submit only one copy of each drawing, in reproducible format. The Architect will mark review comments on the reproducible drawing so that the contractor can make as many copies as may be required.

3.5 SAMPLE BOARD:

A. Provide one sample board to display the following:
1. 12" sample of every type of cable used, with connectors and cable labels. The type and function of each cable shall be identified below each sample. Connectors are required on one end only. On the opposite end, strip the outer jacket back 3".
2. One of each type faceplate, with jacks and labels.

B. Sample board will not be returned.

3.6 ATTACHMENT NO. 1:

A. Shall be filled out and returned with shop drawings. List all firms that will be providing work under Division 27.

ATTACHMENT NO. 1

The purpose of this form is to identify all organizations that will provide the work of Division 27, and describe how the work will be divided.

ORGANIZATION:

SYSTEM TO BE INSTALLED: FIRE ALARM SYSTEM

SYSTEM MANUFACTURER:

ORGANIZATION:

SYSTEM TO BE INSTALLED: INTRUSION DETECTION SYSTEM

SYSTEM MANUFACTURER:

ORGANIZATION:

SYSTEM TO BE INSTALLED: INTERCOM SYSTEM

SYSTEM MANUFACTURER:

ORGANIZATION:

SYSTEM TO BE INSTALLED: VOICE REINFORCEMENT SYSTEMS

SYSTEM MANUFACTURER:

Attach a letter from each organization stating that they acknowledge and will comply with the staffing requirements of Section 270100 and that the proposed subdivision of work of Division 27, among the organizations will not compromise the integrity of the systems and does not conflict with recommendations of the equipment manufacturer, or applicable codes.

END OF SECTION 27 01 20

SECTION 27 10 10 - INTELLIGENT FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION:

A. The work required under this section of the specifications consists of an analog, addressable fire and voice alarm system.

B. *This is a performance-based specification*. The system specified herein shall be designed by the manufacturer or an authorized representative of the manufacturer who is either a registered Fire Protection Engineer or a NICET Certified Engineering Technologist – Level IV.

C. Work of this section requires coordination with the following:

1. Duct work installer.
2. Elevator installer.
3. Electrical system installer.
4. Fire water service installer.
5. Sprinkler installer.
6. Fire pump installer.
7. Electronic card access and door hardware installer(s).

D. Proof of this coordination shall be submitted with the shop drawings.

1.3 QUALITY ASSURANCE:

A. All components shall be U.L listed for their intended use as part of the Intelligent Fire Alarm System. Non-listed equipment shall not be used.

B. No equipment shall be installed nor auxiliary connections made that will inhibit proper operation or use of the system and its components, in accordance with the U.L. listings.

C. Acceptable manufacturers:

1. Notifier
2. EDS
3. Simplex

D. Submittals: Refer to Section 270120 for requirements. A draft copy of the certification required by NFPA 72 shall be submitted with the shop drawings. Fill-in as much information

as possible. Submittals made without this information will be rejected.

1.4 COORDINATION:

A. Coordinate control, supervisory and auxiliary functions with work provided under other Divisions.

1.5 PERFORMANCE CRITERIA:

A. When installed, the system shall comply with the requirements of the State of Georgia ADA, NFPA 72 and NFPA101.

PART 2 - PRODUCTS

2.1 GENERAL:

A. All equipment, components and software shall be new and the manufacturer's current model. Beta versions are not acceptable.

B. Provide and activate all standard alarm, trouble, control and supervisory functions. Provide special functions as specified herein.

2.2 FIRE ALARM CONTROL PANEL:

The fire alarm control panel shall comply with the manufacturer's standard design, materials, components for an intelligent fire alarm system with addressable devices, plus the following accessories:

A. A digital alarm communicator transmitter (DACT) shall be provided for transmitting alarm and trouble conditions to an IP/GSM fire alarm communicator for cellular reporting.
B. A dedicated supervisory service LED and a dedicated supervisory service acknowledge switch, for the building sprinkler system.

2.3 FIRE ALARM COMMUNICATOR:

A. Provide a dual path IP/GSM fire alarm communicator connected to the fire alarm control panel digital alarm communicator transmitter (DACT). The system shall be capable of transmitting alarms, supervisory and trouble signals to a 3rd party monitoring company. Coordinate with owner to determine which 3rd party monitoring company is being used.
B. IP/GSM communicator shall be mounted adjacent to the fire alarm control panel.
C. GSM (cellular) communication only shall be provided for this project.
D. The communicator shall communicate to GSM networks including 2G, 3G and 4G. The multi-GSM platform technology shall automatically detects and chooses the best network in the area based on signal strength and shall self-adjusts for operation.
E. Provide an exterior building mounted antenna connected to the IP/GSM communicator when the cellular signal strength is below -70dBm at the fire alarm control panel.
F. The communication path shall be supervised at an interval of not more than 60 minutes. A failure to complete a signal transmission shall be annunciated at the fire alarm control panel

and remote annunciator.

G. The equipment enclosure shall have diagnostic LEDs for signal strength and status indications.
H. The IP/GSM communicator shall be housed in a UL listed cabinet. The backbox and door shall be constructed of steel with provisions for electrical conduit connections into the sides and top.
I. Upon loss of primary (AC) power, the battery shall have sufficient capacity to power the IP/GSM communicator for required standby time (24 hours) followed by 5 minutes of alarm.
J. The communicator shall comply with requirements of NFPA Standard No. 72.
K. The communicator shall be a product of the fire alarm control panel manufacturer.

2.4 DOCUMENTATION CABINET:

A. Provide documentation cabinet located at the fire alarm control panel. Documentation cabinet shall house all record documentation required by NFPA 72.

B. Label documentation cabinet “SYSTEM RECORD DOCUMENTS”.

2.5 REMOTE ANNUNCIATOR:

A. The annunciator panel shall be recess mounted at location noted on the drawings and shall have an LCD readout. Each alarm initiating device (pull station, smoke detector, duct detector, and sprinkler system flow switch) shall be identified on the readout.

2.6 VOICE ALARM PANELS:

A. Provide voice alarm integral with the fire alarm panel.

B. Voice alarm feature shall be capable of transmitting automatic or manual messages to fire alarm speakers. However, panels shall be configured for automatic operation.

2.7 POWER SUPPLIES:

A. Provide power supplies in the quantity and size required to operate the devices connected to the system. Do not load any power supply more than 75% of its rating.

B. Group devices of the same type to the same power supply.

C. Remote power supplies are permitted providing:

1. Location is approved by the Engineer.
2. A separate 20A / 120V circuit is installed to operate each remote supply.
3. Backup battery system is installed at the location of each remote power supply.

2.8 BACKUP BATTERY SYSTEM:

A. An automatic battery back-up and recharging system with volt meter and ammeter for supporting the entire system for a period of 24 hours under normal conditions with five minutes of alarm time at the end of the 24-hour period. The battery back-up shall also be able to support the one-way voice communications and tone generator under maximum normal load for 24 hours and then shall be capable of operating the system during a fire or other emergency condition for a period of 2 hours. Fifteen minutes of evacuation alarm operation at maximum connected load shall be considered the equivalent of 2 hours of emergency operation.

B. Install batteries in a separate cabinet adjacent to the control panel / remote power supply.

2.9 SIGNALING LINE CIRCUITS:

A. Circuits shall be Class B, Style 4.

2.10 NOTIFICATION APPLIANCE CIRCUITS:

A. Circuits shall be Class B, Style Y.

2.11 SYSTEM OPERATION:

A. The system shall be designed, installed and connected to receive and process signals in accordance with NFPA 72.

B. Control actions upon receipt of fire alarm signal:

1. Doors in fire walls, held open by magnetic devices, shall close, via interface with control module.
2. All doors locked by the electronic card entry/control system shall be unlocked, via interface with control module. The electronic card entry/control system is being provided by the Owner. It shall be the responsibility of the contractor to meet with the Owner’s designated representative and determine the requirements.
3. Air handling units equipped with smoke detectors shall be de-energized, via interface with control module.
4. Smoke dampers in duct work shall close, via interface with control module.
5. The alarm activation of any elevator lobby, elevator shaft or elevator equipment room detector shall cause the elevator cabs to be recalled in accordance with ASME A17.1.
6. The alarm activation of any heat detectors in the elevator shaft or elevator machine room shall cause shutdown of elevator power and lighting circuits as required by ASME A17.1.
7. The activation of projected beam detectors shall initiate the actions described in the applicable sections of Division 15, for smoke removal.

C. Supervisory Functions:

1. Sprinkler system flow and tamper switches - per NFPA 72, via interface with monitor module.
2. Fire service post indicator valve - per NFPA 72, via interface with monitor module.

3. Elevator sump pump oil monitoring system.

D. Auxiliary Functions:

1. Provide fire alarm operation of the shunt-trip devices controlling the power to Gymnasium Voice Reinforcement panel and the Multipurpose Voice Reinforcement panel.

2.10 NON-ADDRESSABLE DEVICES:

A. Audible Alarm Indicating Appliances:

1. Audible signals shall be manufacturer's standard horn or speaker, as indicated, and shall be suitable for surface mounting on the wall.
2. Horns shall have field-selectable "standard" and "high" settings.
3. Speakers shall have field-selectable taps from 1/8W to 8W.
4. Enclosure shall be white.

B. Visual Alarm Indicating Appliances:

1. Visual signals shall be manufacturer's standard, suitable for surface mounting on the wall.
2. Devices shall have field-selectable candela settings of 15, 30, 75 or 100 cd.
3. Enclosure shall be white. Lens shall be vandal resistant.

C. Audio/Visual Alarm Indicating Appliances:

1. Combination audible / visible signals shall be manufacturer's standard, the same as defined for individual devices.

D. Door Holders:

1. Magnetic door holders shall be manufacturer's standard and shall have an approximate holding force of 35 lbs.
2. The door portion shall have a stainless steel pivotal mounted armature with shock absorbing nylon bearing. Wall unit shall be semi-flush mounted over recessed outlet box.
3. Door holders shall be 24V dc and shall be powered from the control panel.
4. Door holders shall be wall mounted type unless floor mounted type is required. Door holders shall be compatible with architectural building features and existing doors.

E. Thermal Detector Head:

1. Detectors will be a combination rate-of-rise and fixed temperature (200ºF) type, automatically restorable. These devices shall be used only in spaces where high ambient temperatures prohibit the use of addressable devices. Unless noted otherwise, each of these devices shall be used in conjunction with a monitor module, such that point identification is maintained.

F. Waterflow Switches:

1. Flow switches are furnished and installed under Division 21 (or are existing, see plans for locations) and connected under this Division.

G. Sprinkler Valve Tamper Switches:

1. Tamper switches are furnished and installed under Division 21 and connected under this Division.

H. Post Indicator Valves:

1. Post Indicator Valves are existing and shall be connected under this Division.

2.11 ADDRESSABLE DEVICES:

A. Pull Stations:

1. Pull stations shall contain electronics that communicate the station's status to the control panel over two wires. Station address shall be field-selectable.
2. Stations shall be single-action type.
3. Enclosure shall be red, high-impact, vandal-resistant type.
4. Station address shall be field-selectable.

B. Thermal Detector Heat:

1. They will be combination rate-of-rise and fixed temperature (135ºF) type, automatically restorable.
2. Station address shall be field-selectable.

C. Carbon Monoxide Detector / Alarm:

1. CO sensors shall communicate actual CO values to the system control panel.
2. Sensors shall be low profile.
3. Station address shall be field-selectable.
4. Set points shall be field-selectable from the control panel.
5. Sensor shall have integral test switch.
6. Sensor shall be equipped with sounder base.

D. Smoke Sensors:

1. Smoke sensors shall be of the photoelectric or ionization type and shall communicate actual smoke chamber values to the system control panel. Sensors installed in elevator shafts or pits shall be suitable for the environment.
2. Sensors shall be low profile.
3. Station address shall be field-selectable.
4. Set points shall be field-selectable from the control panel.
5. Sensor shall have integral test switch.
6. Sensor heads shall be photoelectric or ionization type, as determined by the manufacturer

to best suit the environment in which the device is to be installed.

E. Addressable Duct Smoke Detector:

1. Addressable Duct Smoke Detectors shall be of the photoelectric type specified above, for mounting outside of the air stream.
2. Provide housing to allow installation on the side of air duct.
3. Provide sampling tubes.
4. Provide and install an externally mounted addressable control module for each duct mounted smoke detector shown on Division 23 plans and/or details and program system as necessary for required automatic shut-down.
5. For each duct detector location provide one remote indicator / test switch unit. The unit shall provide status of the detector (normal, alarm, and trouble). Flush mount in wall near entrance to room in which air unit is installed.

F. Addressable Monitor Modules:

1. Addressable monitor modules shall provide point-monitoring capabilities of individual non-addressable devices. Provide a separate module for each such device.
2. Locate within three feet of the device to be monitored.

G. Addressable Control Module:

1. Addressable control modules shall be used to initiate control actions and supervise initiating functions. A separate control module shall be provided for each control point. Initiation of control functions from auxiliary contacts in devices is prohibited.
2. Locate within three feet of the device to be controlled.
3. If the power requirements of the device being controlled exceed the contact rating of control module, provide a general purpose relay, controlled by the module, with the required contact rating to support the load.

2.12 REMOTE COMMUNICATION DEVICES:

A. Provide active RS-232 port for connection of printer.

B. Provide remote LCD annunciator (non-control type) in location shown on plans.

PART 3 - EXECUTION

3.1 WIRING:

A. Refer to Section 279010, Wiring Methods for Communications Systems.

B. Label each piece of equipment and each cable, using NFPA 72 requirements/ recommendations. Label each end of all cables. Labels shall be of same type as specified in Section 272011.

C. Provide all wiring required to make system operable, as specified. Leave 25% spare capacity

on each circuit for the future addition of devices and appliances. Voltage drop calculations shall substantiate initial load and load that can be added.

D. Install wires and cables without splices. Make connections at terminal strips in cabinets or at equipment/device terminals.

3.2 CONDUCTORS:

A. Provide cable type construction, listed and approved for fire alarm usage.

B. Cables shall comply with NEC Article 760, be red in color and be identified in all enclosures.

C. *All cables shall be installed in a metallic conduit system where not located above an accessible ceiling,* in accordance with Section 261010. Minimum conduit size shall be 3/4". All junction boxes and conduit shall be painted red.

3.3 DEVICES:

A. The location of devices shown is approximate. The exact location of all devices shall be determined by the system designer.

3.4 DISCONNECT LABELING:

A. The panel and circuit number serving the control panel shall be marked with an indelible marker pen on the inside door of the control panel.

3.5 NOTIFICATION APPLIANCES:

A. The sound level and light intensity setting of notification devices shall be determined by the system designer.

3.6 DUCT MOUNTED DETECTORS:

A. Field verify the quantity and location of duct mounted smoke detectors.

B. Detectors shall be mounted similar to existing, the method of mounting the detector housing shall provide an access door in the duct work on the side opposite of the detector, for inspection of the sampling tubes.

3.7 PRELIMINARY TESTS:

A. Upon completion of the installation, test the entire system for proper operation. Make all adjustments and corrections necessary. Retest until proper operation is achieved.

3.8 CUSTOMIZATION:

A. Schedule on-site meeting (allow a minimum of 4 hours) with Owner's designated representative and review system operation to:

1. Determine custom labels.
2. Customize software programming for initiation, notification and control circuits.
3. Review all adjustable features and determine setpoints.
4. Determine access levels and assign passwords.
5. Implement customization based on meeting with Owner. Document all settings and provide hard copy.

3.9 FINAL TEST:

A. After customizing system, perform an acceptance test of the system as required by NFPA 72. Upon completion of tests, print alarm history log to verify tests.

B. Upon successful completion of tests, provide written certification per NFPA 72. Submit form with record documents.

C. Review test results with Owner and Engineer. Demonstrate system operation as directed.

D. Arrange final inspection with the Fire Marshal and Owner's Insurance representative. Present copy of final test alarm log and NFPA certification to each. Demonstrate operation of system as directed.

E. Any changes made to the system after or as a result of the test shall require re-acceptance testing as required by NFPA 72.

3.10 SPARE PARTS:

A. Provide spare parts as follows – each school site:

1.	Sensor heads:	12 of each type
2.	Sensor bases:	12 of each type
3.	Manual stations:	6
4.	Notification appliances:	12 of each type
5.	Control and monitor modules:	6 of each type

Deliver in unopened factory cartons at time of training. Submit receipt, signed by Owner's representative.

END OF SECTION 27 10 10

SECTION 27 20 11 - CABLE PLANT LABELING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 GENERAL:

A. Provide labels for all cables, device faceplates, equipment and equipment ports, installed on this project, as specified herein.

B. Colors for cables and devices are specified in the respective system specification section.

C. Device plate numbers within a room or space shall be assigned based on the “plan” view of the room or space, starting on the left side of the “top” wall and proceeding around the room to the “right”, “bottom” and “left” walls. Any remaining devices (i.e. floor or column-mounted outlets in the middle of the room), shall be then counted from left-to-right, top-to-bottom.

1.3 QUALITY ASSURANCE:

A. Labeling materials described herein are the product of Panduit. Products of other cabling system manufacturers’ listed in Specification Section 272011, and complying with the requirements specified herein, are acceptable.

B. Submittals: Refer to Section 270120 for requirements. Labels shall be included on layout drawings.

1.4 SYSTEM IDENTIFICATION STRINGS:

A. Fire Alarm:

1. Cable: Provide a label at each end of all cables and at any interim points of termination.

   FA-SLC-PL-01

   FA = Fire Alarm
   SLC = Signaling line circuit or NAC = Notification Appliance Circuit
   PL= Power limited circuit or NPL = Non-power limited circuit
   01 = Circuit number or loop number

2. Device: Provide a label for each device.

ID-01-001

ID =Initiating Device, CD=Control Device, NA=Notification Appliance
01=Circuit number or loop number
001=Unique device point identification

B. One-Way Paging System:

1. Cable (at headend)

PA-01
PA = Paging System
= Paging zone, sequentially numbered

2. Speaker

PA-01

PA = Paging System
01 = Paging zone, sequentially numbered
25 = Sequential speaker number on given zone

PART 2 – PRODUCTS

2.1 LABELS:

A. Cable labels shall be heat shrink type with clear protective cover. Select size and type based on individual cable characteristics. Use black letters on white background except for data / voice / IP cables that exceed the maximum design length. In such cases labels shall be red on white background.

B. Faceplate labels shall be adhesive-backed component label, compatible with label window in faceplate.

C. Equipment port labels shall be adhesive-backed component label, compatible with label area.

D. Equipment and device labels shall be adhesive-backed component label, affixed to the back side of item, or in an otherwise accessible but inconspicuous location.

E. Set lettering height for each type label to provide the largest font possible in the space available. Boldface Aerial font is preferred. However, labels shall be sized and formatted such that they can be read from a distance of 24".

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Cable labels defined herein shall not be applied until the cables have been terminated and trimmed. Provide temporary labels at the time of cable installation. Temporary labels shall have the same information as permanent labels.

B. Use extreme caution when applying heat shrink labels.

C. Schedule computer time, with the Using Agency, to generate the labels.

D. Apply cable labels within 2" of termination, or fan-out, such that the lettering is visible without twisting or bending the cable.

3.2 AS-BUILT LABEL REPORT:

A. This report is applicable to Data / IP / Voice cable systems only.

B. Prior to system acceptance, the Contractor shall update the system layout drawings specified in Section 270120, for all changes made during the installation.

END OF SECTION 27 20 11

SECTION 27 30 00 - AREA OF REFUGE ASSISTANCE COMMUNICATIONS SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SCOPE OF WORK:

A. Provide a complete operational system as indicated on the drawings and as specified herein.

B. *This is a performance-based specification*. The system specified herein shall be designed by the manufacturer or an authorized representative of the manufacturer. All hardware, cabling, and programming required to provide the system described below shall be provided.

1.03 QUALITY ASSURANCE:

A. Acceptable Manufacturer's:

1. Rath
2. Talkaphone
3. Prior approved manufacturer.

B. Submittals: Refer to Section 270120 for requirements.

PART 2 - PRODUCTS

2.01 EQUIPMENT AND MATERIAL, GENERAL:

A. All equipment, components and software shall be new and the manufacturer’s current model. Beta versions are not acceptable.

2.02 FEATURES AND FUNCTIONS:

A. The area of refuge communications and system shall be a comprehensive communications network with the following features and functions.

1. Capacity for the number of stations indicated on the drawings plus 20% spare.

2.03 EQUIPMENT:

A. Base Station:

1. The Base Station shall be located at a central control point on the first floor as indicated on the plan or as determined by local Authority having jurisdiction. The Base Station shall be capable of receiving input from a minimum of 5 Call Boxes. The base station shall have visual LED indicator lights, one for each call box. The Base Station shall allow communication to all call boxes simultaneously and to each individual Call Box. The Base Station shall provide an audible and visual indicator when a Call Box has been activated.

2. The Base Station shall be flush mounted, equal to Rath models 2500-205FM, with stainless steel housing, red coil cord emergency Handset, be 24vdc or 120vac powered and include a rechargeable battery to maintain backup power for a minimum of 4 hours of Talk time.

B. Call Boxes:

1. Call boxes shall be ADA compliant, vandal resistant hands free speakerphone with LED indicators to indicate status of call. Call Box shall be Hands-Free with a push-button-once to talk system. Upon activation of the emergency push button at the Call Box, a call shall be transmitted to the Base Station. If no answers at the Base Station, the Call Box shall automatically dial a secondary location outside the building to activate two way off-site person to person voice communications. Call Boxes shall be programmed with 5 emergency phone numbers. Each Call Boxes shall be programed with its specific location. The programmed location shall indicate at the Base Station upon activation of the Call Box.

2. Call Box features:
   a. Five number programming.
   b. Operating Temperature of between -40˚F to +150˚F (-40˚ to + 65˚ C)
   c. Programmable passwords.
   d. On-Site or Remote Programmable.
   e. EEPROM memory to protect programming.
   f. Braille faceplate.

3. Call Boxes shall be flush mounted, equal to Rath models 2100-958NSR.

C. Strobe

1. When Call Station is activated, a strobe shall begin flashing at the Base Station location. Strobe shall continue to flash as long as any Call Stations are active.

2. Strobe shall be rated at 15 candela and flash 60 times per minute.

D. Power supplies:

1. Provide 24vdc Power Supply. System shall be capable of supplying power to a minimum

of 10 Call Boxes and the Base Station.

2. Power Supply shall be equal to Rath model 2500-PWR24

2.04 EMERGENCY CALLS:

A. Once the Call Box button has been pushed, the Call Box shall call the Base Station. If no answer at the Base Station, it will automatically call preprogrammed emergency numbers. Call Box shall have Location Messaging. Call Box shall have a minimum 18 second recordable message, programmable to play 2 times. Call Box shall notify called party of the location of the call upon being received at the emergency dispatch center. Call Box shall be capable of allowing the called party to replay the Location Message if necessary to ensure an understanding of the caller location. If system is not attended the Call Box shall dial a secondary location outside the building to activate two way off-site person to person voice communications. Once a call has been made (button pushed), the call can only be terminated by the called party. Call Box shall have a red LED that illuminate upon activation of the button. The light shall be a solid color when the Call Box is activated, and will flash when call has been answered.

B. The system shall be capable of being programmed and reprogrammed on-site and remotely.

PART 3 – EXECUTION

3.01 INSTALLATION OF EQUIPMENT:

A. Install equipment where shown, in accordance with the equipment manufacturer's written instructions, and with recognized industry practices, to ensure that the equipment complies with these requirements and serves the intended purposes. Comply with the requirements of National Electrical Code an applicable portions of NECA's "Standard of Installation" pertaining to general electrical installation practices. Ground equipment enclosures, surge arrestors and cable shields in accordance with the National Electrical Code.

3.02 WIRING:

A. Wiring is not shown on the drawings. Provide wiring of the type recommended by the system manufacturer. Wiring shall run unspliced. Install all wiring in accordance Section 279010. Provide phone line to base station.

3.03 TESTING :

A. Upon completion of installation of equipment, test to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting until specified operation is achieved. Do not proceed with in-service training until

the system is fully operational.

3.04 PROGRAMMING:

A. After system start-up and prior to final testing, schedule on-site meeting with the Owner's representative to discuss desired programming of system. Program as directed. Provide documentation and include in record manuals. Allow one 8-hour day.

END OF SECTION 27 30 00

SECTION 27 50 10 - INTRUSION DETECTION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SCOPE OF WORK:

A. The scope of work shall consist of providing a complete, operable, local intrusion detection system with **IP connection** to the owner's monitoring company. Provide all labor, equipment, materials, programming, supervision and testing required to complete the work.

1.3 QUALITY ASSURANCE:

A. Acceptable Manufacturer's: This specification is based on a Bosch 7412G4 series system. Equals such as Honeywell Ademco Vista 32FBP and others will be considered on a prior approval basis only.

B. Submittals: Refer to Section 270120 for requirements.

C. Installer Qualification:
   a. Minimum of five years experience installing access control, surveillance and security systems and devices.
   b. After-sales support: The Contractor shall be a factory-authorized and trained dealer of the system and shall be factory-trained and certified to maintain/repair the system after system acceptance. Dealer shall be within a 100 Mile Radius of the facility.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION:

A. The Digital Alarm Communicator System (DACS) specified herein shall include a Digital Alarm Communicator Transmitter (DACT), built-in telephone line monitor, 500 event memory logger, real time clock, calendar, test timer, battery charging / voltage supervision circuitry, battery lead supervision, diagnostics displays, time / event based scheduling system, lightning / EMI protection circuits, and the associated optional modules and components for a complete system.

1. The DACS control panel shall be Bosch Security Systems, Inc.

B. Point Functionality and Expansion:
   1. Each point in the system shall be programmable to provide the following type of response in the system:
      a. Always on (24 hour response).
      b. On when the system is Master Armed.
      c. Only on when the system is Perimeter Armed.
      d. Displays / Does Not Display at the ACC when the point is activated.
      e. Provides / Does Not Provide entry warning tone.
      f. Sounds / Does Not Sound audible alarm indication.
      g. The Point is bypassable / not bypassable.
      h. Alarm Verification with programmable verification time.
      i. Relay activation by Point.
      j. Provides / Does Not Provide "watch point" capability.
      k. Provides Swinger Bypass.
      l. Defers Bypass Report.
      m. Can return to the system after being force armed and then restoring.
      n. Can return to the system after being bypassed and then restoring.
   2. The DACS shall be capable of supporting "group zoning." Group zoning refers to the combining of points into a separately identifiable and separately annunciated (programmable text) areas.
   3. The DACS shall be capable of allowing variable point response times via programming. Point response times shall be programmable over a range of 300 milliseconds to 4.5 seconds.
   4. The DACS shall have the capability to expand up to 75 separately identifiable points, of which 8 are on-board and 67 are off-board addressable points connected to multiplexed backbone trunks via wired modules and/or wireless receivers.
      a. The 8 on-board points shall be able to accommodate powered class B functionality using a powered loop interface module.
      b. Point Expansion Modules (Wired and Wireless) shall be able to be located remote to the main panel to a maximum distance of 1000 feet.
   5. Capability to expand up to 40 separately-identifiable points of which 8 are on-board points and 32 are off-board addressable points connected to point expansion modules and/or wireless receivers.
   6. Capability to expand up to 24 separately-identifiable points of which 8 are on-board points and 16 are off-board addressable points connected to point expansion modules and/or wireless receivers

C. Areas/Accounts:
   1. The DACS shall support 8 independent areas.
   2. The DACS shall be capable of linking multiple areas to a shared area which may be automatically controlled (hallway or lobby).
   3. The DACS shall accommodate conditional area arming dependant on the state of other areas (master or associate). Any area can be configured for perimeter and interior arming, not requiring a separate area for this function.

D. Output Relay Expansion: The DACS shall provide the capability for output relay expansion using relay expansion modules. Independent control of relay functions by area shall be possible through programming assignments

E. Scheduling: The DACS shall support scheduling capabilities with the following characteristics:
   1. Arm / Disarm specific area(s) based on open/close windows.
   2. Bypass / Unbypass point(s).
   3. Activate / Deactivate relay(s).
   4. Send test reports.
   5. Up to 4 programmable holiday schedules of 366 days each (includes leap year). Based on the holiday settings, different time windows for open/close and other system functions can be executed.
   6. Automatic adjustment of system clock for daylight savings time.
   7. Turn an Access Authority Level On / Off.
   8. Hold a Door Open (unlocked and shunted).
   9. Secure a Door Closed (locked, no valid cards will allow entry).
   10. Return a Door to Normal Operation (locked, valid cards will allow entry).
   11. Turn recording of Access Granted events On/ Off (and transmittal if routing is ON).
   12. Turn recording of Access Denied events On/ Off (and transmittal if routing is ON).

F. Alarm Command Centers:

   1. The DACS shall accommodate connection with up to 8 ACCs, each capable of displaying custom English text on liquid crystal or vacuum fluorescent (VF) displays.
   2. The ACC's shall be capable of displaying point status, arm/disarm status, and carry out user command functions.
   3. The ACC can be programmed to respond to the entry of any of the specifically authorized user passcodes.
   4. The ACCs shall be able to be configured to control a specific area, or group of areas, or all areas in the system.
   5. The ACCs shall be able to be temporarily re-addressed to view the status of a remote area.
   6. The ACC's shall be able to provide different audible tones for Intrusion, Fire alarms, and system troubles

G. User Passcodes and Authority: Passcodes shall be programmable with authority levels to allow users to operate any or all areas

H. Communication: The DACS shall be capable of reporting system events and supervisory reports including alarm, trouble, missing modules, restorals, system status, AC failure, battery status to primary and secondary off-site DACR's.

I. Network Communication: The DACS shall be capable of network communications over a LAN, WAN, Intranet, or the Internet. The system shall include supervision of the network communication utilizing configurable periodic heartbeats to the Digital Alarm Communications Receiver (DACR). The DACR shall provide notification of the loss of communications from a networked system after a programmable timeframe since the last communication.

J. Event Log: The DACS shall maintain a log of events indicating time, day, month, year type of event, account number, area number, user ID, point text, user text and primary/secondary event route. The system shall allow the following characteristics:

K. Testing, Diagnostic, and Programming Facilities: The DACS shall be capable of sending (manually or automatically) test and status reports to remote DACRs.

L. Primary power: The Contractor shall provide a dedicated 120 VAC power circuit to the DACS system. This circuit shall be connected to the emergency power system. The 120 VAC is stepped down to power the DACS panel using a class two, plug-in transformer. This power circuit shall be properly rated to continuously power all points and functions indefinitely in full alarm condition.

M. Primary power supervision: When the primary power source fails, the system can be configured to report an "AC Fail" message to a commercial central station.

N. Secondary power (standby battery): The Contractor shall provide adequate battery power as defined by the relevant application criteria, (UL 864 and UL 985 for alarm installations or NFPA 72 chapters for fire applications). Appropriate battery chargers shall be provided consistent with the battery back-up capacity. The most current accepted version of NFPA 72 and any applicable local codes or AHJ requirements must be met accordingly.

O. Wiring: The contractor shall provide cables consistent with the manufacturer's recommendations. Exposed wiring shall be installed in conduit.

2.2 ACCESSORIES:

A. SYSTEM HARDWARE DESCRIPTION:

1. DACS System: The DACS shall be provided, at minimum, with the following components and specialized services in the quantities and capacities required to achieve the level of operation specified for the number and types of devices indicated. Additional accessories shall be provided based on the quantities and features required for the application.

2. Annunciation Devices (Keypads):
D1255: Alarm Command Center (ACC) - Built-in multi-tone sounder. Displays status in custom English text on 16 character display. ACCs provide "command menu" user interface. ACC can be supervised. **[**Provide five; install four in the locations indicated and one spare.**]**

3. Motion Sensors:
a. Corridor Unit:
- Bosch DS720i Tri Tech 300 ft range.(Supply with a 8127U addressable Module)
- Bosch ISC-PDL1 Tritech 80 ft. range. (Supply with a 8127U addressable Module)

b. Room Unit: Bosch ISC-PDL1 Tritech Motion detector. (Supply with a 8127U addressable Module)

c. Gym and Multipurpose rooms: DS9730 PIR (up to 25ft Mounting height) (Supply with a 8127U addressable Module)

4. Magnetic Door Contacts: Bosch ISN-CTC75 (Supply with addressable module 8127U.

PART 3 – EXECUTION

3.1 GENERAL:

A. System wiring is not shown on the drawings. Provide all wiring required to place the system into operation.

B. Wiring shall be installed in accordance with Section 279010, Wiring Methods for Communications Systems. Exposed wiring shall be installed in conduit.

C. Where there are a number of power requiring devices, group in numbers so power required does not exceed 80% of manufacturer's power supply rating. Provide extra wiring, or extra power supplies required to fulfill that requirement. In addition, provide extra or larger size wiring to alleviate voltage drops which makes device operate beyond voltage limits for which it was designed.

3.2 SENSOR LOCATIONS:

A. The locations shown for detectors is schematic in nature, intended to designate spaces in which detectors are to be installed and the anticipated location of the detectors within the space. The actual locations shall be determined by the installer based on a field survey of each space.

B. Cables may be pulled into space before sensors are installed and coiled above ceiling. Leave sufficient slack so that sensor location can be adjusted, if required by the field survey. Wall outlet rough-in is not required in spaces with accessible, suspended ceilings, where sensor is located within 12" of ceiling. Under such conditions, cable shall be neatly trained down the wall and shall be supported. Provide a white plastic split-cover grommet at ceiling penetration.

C. Program the local system to operate as specified.

D. Program the ACC's as follows :

1. Kitchen : To activate/deactivate kitchen and cafeteria area sensors.
2. Cafeteria : To activate/deactivate cafeteria sensors.
3. Gym : To activate/deactivate gym sensors.
4. Main Entrance: To activate/deactivate administration area sensors and to activate/deactivate all sensors in the school.
5. Primary Staff Entry: To activate and deactivate the main and class room corridors.

3.3 TESTING, CUSTOMIZATION, CERTIFICATION AND TRAINING:

A. Preliminary Tests: Upon completion of the installation, test the local system and remote station for proper operation. Make all adjustments and corrections necessary. Retest until proper operation is achieved.

B. Customization: Schedule on-site meeting with Owner's designated representative and review system operation to:

1. Determine custom labels.
2. Determine access levels and assign passwords.
3. Review all adjustable features and determine setpoints.
4. Verify that ACC programming is consistent with intended use of facility and determine if changes are necessary.

C. This work is applicable to both the local system and central station. Allow a minimum of one 8-hour day for meeting with the Owner's designated representatives. Upon completion, customize system and document all settings. This work shall not commence until the system is 100% operational.

D. Final Test: After customizing system, perform walk-test of local system. Initiate an alarm condition on each device in the system. Initiate a trouble condition on at least one of each type device per area. The central station connection may be disabled during testing except to the extent necessary to verify that the central station is operating properly. Upon completion of tests, print alarm history log to verify tests and then clear the log.

E. Certification: Upon completion of final tests, provide written certification that the system has been customized and is fully operation in accordance with the Owner's requirements.

F. Final Inspection (Architect/Owner): Review test results with Owner and Architect. Demonstrate system operation as directed.

END OF SECTION 27 50 10

SECTION 27 90 10 - WIRING METHODS FOR COMMUNICATIONS AND ALARM SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION:

A. The work required by this section of the specifications applies to all systems specified under Division 27 and the HVAC systems control cabling specified under Division 23.

B. Installation of outlet boxes, raceway systems, cable trays and sleeves is specified under Division 26. Intermediate cable supporting systems, for cables not installed in cable trays is specified in this Section of the work.

1.3 QUALITY ASSURANCE:

A. Submittals: Refer to Section 270120.

PART 2 - PRODUCTS

2.1 CABLE CHARACTERISTICS:

A. Wire size, shielding and insulation requirements for cables shall be determined by the system manufacturer for each system based on specific system requirements, the National Electrical Code and EIA/TIA standards.

B. Cables installed outdoors or run below grade shall be suitable for use in wet locations.

C. All indoor cables shall be plenum-rated, type CMP. Cables penetrating floors shall be riser rated, type CMR in accordance with Article 800 of the NEC.

D. Tie wraps shall be Velcro, plenum-rated type.

E. Bridle rings shall be tiered-type, with a separate tier for each system cable, such as CableCat clips manufactured by Caddy. Provide wide-body saddles for each ring.

2.2 SURGE SUPPRESSION:

A. Provide surge protection for conductors in accordance with NEC Article 800, where conductors enter and exit buildings.

B. Provide surge protection for the 120V incoming power connections to all headend equipment.

PART 3 - EXECUTION

3.1 GENERAL:

A. Wiring methods shall comply with Articles 725, 760, 800 and 810 of the National Electrical Code for power-limited circuits, and EIA/TIA standards, as applicable.

B. Cable systems, or portions of cable systems, shall be installed in a conduit system under the following conditions:

1. When required by the National Electrical Code
2. When required by the system manufacturer
3. To prevent or eliminate interference from cables of one system to another or from outside sources to cable systems.
4. Wiring concealed in walls
5. Wiring run above inaccessible ceilings
6. Cables penetrating walls and floors.
7. Wiring run exposed on interior walls (i.e. unfinished spaces)
8. Wiring run below grade, both inside and outside of the building footprint.
9. (Indoors in spaces or outdoors), and wiring run below grade shall be installed in raceways.
10. All fire alarm system cables.

C. Unless specifically noted, required by the National Electrical Code or system manufacturer, wiring above accessible ceilings is not required to be installed in conduits.

3.2 MASTER CABLING PLAN:

A. The Contractor shall develop a Master Cabling Plan as defined in Section 270120. The approved plan shall become the basis of installation for all systems governed by this section of the work.

3.3 CABLE SYSTEM AND CONDUIT SYSTEM ROUTES:

A. Complete conduit system not required:

1. Horizontal cables shall be routed in the cable tray systems installed under Division 26, and bridle rings installed under this Division of the work. Cable tray routes have been predefined, but may be adjusted to suit the master cabling plan, subject to the Architect’s approval. The location of bridle rings shall be field determined based on this specification.
2. Vertical cable drops shall be installed in conduits installed under Division 26.
3. Cables passing through walls and floors shall be installed in conduit sleeves installed under Division 26. The sealing of all sleeves is also specified under Division 26.

B. Complete conduit system required:

1. Cables shall be installed in a complete conduit system installed under Division 26.

3.4 INTERMEDIATE SUPPORTS:

A. Cables not installed in cable trays shall be supported by bridle rings installed under this Division of the work. Provide a separate tier for cables of each system. The location of bridle rings shall be determined by the contractor based on the approved Master Cabling Plan, required by Section 270120. The Contractor shall develop the pathways based on these specifications.

B. Bridle rings shall be installed no more than 5 feet apart on straight runs and within 12" of all corners

C. Bridle rings shall be attached to the building structure. The installation of cables shall not inhibit the removal of accessible ceiling panels. This precludes using ceiling panels as a means of support. Do not support cables from conduit or piping systems.

D. Cables shall be run parallel or perpendicular to the building structure in all three planes. Cables shall be readily accessible.

E. Grouping and Securing: Group all cables of one system along entire length of run using cable ties installed every 2-1/2 feet. Secure cable groups to bridle rings/j-hooks using cable ties.

3.5 SEPARATION:

A. Maintain a minimum separation of 2" between cables of different systems. Make crossovers as recommended by each specific manufacturer.

B. Maintain clearance from sources of interference as outlined in TIA standards.

C. The use of common sleeves through walls and floor is acceptable as long as this installation does not degrade system operation.

END OF SECTION 27 90 10

SECTION 31 00 00

EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

The work under this section consists, in general, of furnishing all labor, materials, tools, equipment, and incidentals for providing for the excavation, backfilling, and compaction of all structures, utilities, and pavements indicated on the project drawings and as specified herein.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 180	(2001) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in) Drop
AASHTO T 224	(2001) Correction for Coarse Particles in the Soil Compaction Test

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C600	(1999) Installation of Ductile-Iron Water Mains and Their Appurtenances

ASTM INTERNATIONAL (ASTM)

ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D 1140	(2000) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D 1556	(2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 698	(2012) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort
ASTM D 2487	(2000) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(2004) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(2004) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

ASTM D 422	(1963; R 2002) Particle-Size Analysis of Soils
ASTM D 4318	(2000) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 698	(2000ae1) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu.m.))

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 600/4-79/020	(1983) Methods for Chemical Analysis of Water and Wastes
EPA SW-846.3-3a	(1999) Test Methods for Evaluating Solid Waste: Physical/Chemical Methods; Third Edition; Final Update III-A

GEORGIA DEPARTMENT OF TRANSPORTATION (GDOT)

Georgia Department of Transportation Standard Specifications – Construction of Transportation Systems – Current Edition

1.3 DEFINITIONS

1.3.1 Satisfactory or Suitable Materials

Satisfactory embankment fill to be used within five-feet of proposed subgrade under pavements or tracks and finished grade elsewhere (structural fill) shall be onsite or offsite materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, SW, SP, SP-SM, and SM, inorganic soils with a maximum dry density of 90 pcf. The plasticity index shall not be greater than 10 percent under pavements, tracks, or buildings and greater than 30 percent elsewhere when tested in accordance with ASTM D 4318, and not more than 25 percent by weight shall be finer than No. 200 sieve when tested in accordance with ASTM D 1140. Satisfactory materials for grading shall be comprised of stones less than 6 inches, except for fill material under pavements and railroads which shall be comprised of stones less than 3 inches in any dimension.

Satisfactory embankment fill to be used more than five-feet below proposed finish grades and subgrades as indicated above may include rock fragments and topsoil, as long as fill is clean and free of root mats and other fibrous materials. Rock fragments and rock embankments, no larger than three feet in diameter and where allowed, shall be placed in accordance with Georgia DOT Standard Specifications for Construction of Roads and Bridges (current edition).

1.3.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material. The Owner shall be notified of any contaminated materials.

1.3.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic. Testing required for classifying materials shall be in accordance with ASTM D 4318, ASTM C 136, ASTM D 422, and ASTM D 1140.

1.3.4 Degree of Compaction

Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 698 abbreviated as a percent of laboratory maximum density.

1.3.5 Topsoil

Material suitable for topsoils obtained from offsite and onsite areas, or excavations is defined as: Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than one inch diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7.

1.3.6 Hard/Unyielding Materials

Weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" with stones greater than 8 inches in any dimension or as identified elsewhere in this document, whichever is smaller. These materials usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.3.7 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding 1/2 cubic yard in volume. Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

1.3.8 Unstable Material

Unstable material shall consist of materials too wet to properly support the utility pipe, conduit, pavement or appurtenant structure.

1.3.9 Select Granular Material

Select granular material shall consist of materials classified as GW, GP, SW, SP by ASTM D 2487 where indicated. The plasticity index shall not be greater than 5 percent when tested in accordance with ASTM D 4318, and not more than 10 percent by weight shall be finer than No. 200 sieve when tested in accordance with ASTM D 1140.

1.3.10 Rock Embankment Material

Rock Embankment Material is defined in Section 811.2.01 of the *Standard Specifications Construction of Transportation Systems, Georgia Department of Transportation (Standard Specifications)*. Placement details and requirements are cited in Section 208 of the latest version of the *Standard Specifications*.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01300, "Submittals."

A. Preconstruction Submittals

1. Shoring

2. Dewatering Work Plan

Submit 15 days prior to starting work.

B. Test Reports

1. Testing

2. Borrow Site Testing

Within 24 hours of conclusion of physical tests, 3 copies of test results, including calibration curves and results of calibration tests.

C. Certificates & Statements

1. Testing

Qualifications of the independent testing laboratory for approval.

1.5 SUBSURFACE DATA

Subsurface soil boring logs are shown on the drawings and in the geotechnical report. These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations. Contractor is responsible for making any additional subsurface investigations as necessary to perform the specified work.

1.6 CLASSIFICATION OF EXCAVATION

No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.

1.7 CRITERIA FOR BIDDING

Base bids on the following criteria:

A. Surface elevations are as indicated.

B. Pipes or other artificial obstructions, except those indicated, will not be encountered.

C. Ground water elevations indicated by the boring log were those existing at the time subsurface investigations were made and do not necessarily represent ground water elevation at the time of construction.

D. Material character is indicated by the boring logs.

1.8 DEWATERING WORK PLAN

Submit procedures for accomplishing dewatering work.

1.9 SHORING AND SHEET PLAN

See Paragraph 3.4 for requirements.

PART 2 - PRODUCTS

2.1 REQUIREMENTS FOR OFFSITE SOILS

See requirements elsewhere in this Specification.

2.2 BURIED WARNING AND IDENTIFICATION TAPE

Polyethylene plastic and metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.

Warning Tape Color Codes

Red:	Electric
Yellow:	Gas, Oil; Dangerous Materials; Compressed Air
Orange:	Telephone and Other Communications
Blue:	Water Systems
Green:	Sewer Systems

2.2.1 Warning Tape for Metallic Piping

Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.003 inch. Tape shall have a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

2.2.2 Detectable Warning Tape for Non-Metallic Piping

Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.004 inch. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.3 DETECTION WIRE FOR NON-METALLIC PIPING

Detection wire shall be insulated single strand, solid copper with a minimum of 12 AWG.

PART 3 - EXECUTION

3.1 STRIPPING OF TOPSOIL

Topsoil shall be stripped to a depth of 4 inches and stockpiled. Topsoil shall be transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later.

Topsoil shall be kept separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 2 inches in diameter, and other materials that would interfere with planting and maintenance operations. Topsoil shall be spread on all areas to be sodded or seeded. Any surplus topsoil from excavations and grading shall be removed from the site.

3.2 GENERAL EXCAVATION

The Contractor shall perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Grading shall be in conformity with the typical sections shown and the tolerances specified in paragraph FINISHING. Satisfactory excavated materials shall be transported to and placed in fill or embankment within the limits of the work. Unsatisfactory materials encountered below Top of Subgrade shall be excavated below grade and replaced with satisfactory materials as directed. Such excavated material and the satisfactory material ordered as replacement shall be included in excavation. Unsatisfactory excavated material shall be disposed of off the Owner's Property in waste or spoil areas provided by the Contractor as per local regulations. During construction, excavation and fill shall be performed in a manner and sequence that will provide proper drainage at all times. Material required for fill or embankment in excess of that produced by excavation within the grading limits shall be produced from excavated material within the project limits or imported from other approved areas selected by the Contractor as specified.

Remove hard material and rock to elevations indicated in a manner that will leave foundation material in an unshattered and solid condition. Roughen level surfaces and cut sloped surfaces into benches for bond with concrete. Protect shale from conditions causing decomposition along joints or cleavage planes and other types of erosion.

Removal of hard material and rock beyond lines and grades indicated will not be grounds for a claim for additional payment unless previously authorized by the Owner. Excavation of the material claimed as rock shall not be performed until the material has been cross sectioned by the Contractor and approved by the Owner.

3.2.1 Ditches and Channel Changes

Excavation of ditches and channels shall be accomplished by cutting accurately to the cross sections, grades, and elevations shown. Ditches shall not be excavated below grades shown. Excessive open ditch excavation shall be backfilled with satisfactory, thoroughly compacted, material or with suitable stone or cobble to grades shown. Material excavated shall be disposed of as shown or as directed, except that in no case shall material be deposited less than 4 feet from the edge of the ditch. The Contractor shall maintain excavations free from detrimental quantities of leaves, brush, sticks, trash, and other debris until final acceptance of the work.

3.2.2 Drainage Structures

Excavations shall be made to the lines, grades, and elevations shown, or as directed. Trenches and foundation pits shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Rock or other hard foundation material shall be cleaned of loose debris and cut to a firm, level, stepped, or serrated surface. Loose disintegrated rock and thin strata shall be removed. When concrete or masonry is to be placed in an excavated area, the bottom of the excavation shall not be disturbed. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.2.3 Drainage

Provide for the collection and disposal of surface and subsurface water encountered during construction. Completely drain construction site during periods of construction to keep soil materials sufficiently dry. The Contractor shall establish/construct storm drainage features (ponds/basins) at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity and/or provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed.

3.2.4 Dewatering

Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 3 feet of the foundation of any structure, or rail tie, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, the water level shall be maintained continuously, at least 1 (one) foot below the working level. Operate dewatering system continuously until construction work below existing water levels is complete. Submit performance records weekly. Measure and record performance of dewatering system at same time each day by use of observation wells or piezometers installed in conjunction with the dewatering system.

3.2.5 Trench Excavation Requirements

The trench shall be excavated as recommended by the manufacturer of the pipe to be installed. Trench walls below the top of the pipe shall be sloped, or made vertical, and of such width as recommended in the manufacturer's installation manual. Where no manufacturer's installation manual is available, trench walls shall be made vertical. Trench walls more than 4 feet high shall be shored, cut back to a stable slope, or provided with equivalent means of protection for employees who may be exposed to moving ground or cave in. Vertical trench walls more than 3 feet high shall be shored. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes which may be adversely affected by weather or moisture content. The trench width below the top of pipe shall not exceed 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inches inside diameter and shall not exceed 36 inches plus pipe outside diameter for sizes larger than 24 inches inside diameter. Where recommended trench widths are exceeded, redesign, stronger pipe, or special installation procedures shall be utilized by the Contractor. The cost of redesign, stronger pipe, or special installation procedures shall be borne by the Contractor without any additional cost to the Owner.

3.2.5.1 Bottom Preparation

The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 2 inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

3.2.5.2 Removal of Unyielding Material

Where unyielding material is encountered in the bottom of the trench, such material shall be removed 6 inches below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.2.5.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed and replaced to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the resulting material shall be excavated and replaced by the Contractor without additional cost to the Owner.

3.2.5.4 Excavation for Appurtenances

Excavation for manholes, catch-basins, inlets, or similar structures shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Rock shall be cleaned of loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Loose disintegrated rock and thin strata shall be removed. Removal of unstable material shall be as specified above. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.2.6 Underground Utilities

Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. Perform work adjacent to utilities as indicated in accordance with procedures outlined by the utility company. Excavation made with power-driven equipment is not permitted within two feet of known utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the affected Utility. Report damage to utility lines or subsurface construction immediately to the Owner.

3.2.7 Structural Excavation

Ensure that footing subgrades have been inspected and approved prior to concrete placement. Backfill and compact over excavations and changes in grade to 95 percent of ASTM D 698 maximum density.

Footing subgrades shall be hand-cleaned prior to placement of reinforcing steel. If left open for more than one day, area should be covered with a polyethylene sheet. If inclement weather is expected, subgrade shall be covered with 3” of 1000 psi concrete.

3.2.8 Rock and Unyielding Material Excavation

Blasting will be permitted only when proper precautions are taken for the safety of all persons, the work, and the property. All damage done to the work or property shall be repaired at the Contractor's expense. All operations of the Contractor in connection with the transportation, storage, and use of explosives shall conform to all state and local regulations and explosive

manufacturers' instructions, with applicable approved permits reviewed by the Engineer. Any approval given, however, will not relieve the Contractor of his/her responsibility in blasting operations.

Where blasting is approved, the Contractor shall employ a vibration consultant, approved by the Engineer, to advise on explosive charge weights per delay and to analyze records from seismograph recordings. The seismograph shall be capable of producing a permanent record of the three components of the motion in terms of particle velocity, and in addition shall be capable of internal dynamic calibration.

In each distinct blasting area, where pertinent factors affecting blast vibrations and their effects in the area remain the same, the Contractor shall submit a blasting plan of the initial blasts to the Engineer for approval. This plan must consist of hole size, depth, spacing, burden, type of explosives, type of delay sequence, maximum amount of explosive on any one delay period, depth of rock, and depth of overburden if any. The maximum explosive charge weights per delay included in the plan shall not be increased without the approval of the engineering.

The Contractor shall keep a record of each blast fired—its date, time and location; the amount of explosives used, maximum explosive charge weight per delay period, and, where necessary, seismograph records identified by instrument number and location. These records shall be made available to the Engineer on a monthly basis or in tabulated form at other times as required.

3.3 SELECTION OF BORROW (OFF-SITE) MATERIAL

Borrow material shall be selected to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Borrow material shall be obtained from the borrow areas from approved private sources. Unless otherwise provided in the contract, the Contractor shall obtain from the owners the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling. Unless specifically provided or indicated in the construction documents, no borrow shall be obtained within the limits of the project site without prior written approval. Necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon shall be considered related operations to the borrow excavation.

3.4 SHORING

3.4.1 General Requirements

The Contractor shall submit a Shoring and Sheeting Plan for approval 15 days prior to starting work. Submit drawings and calculations, certified by a Registered Professional Engineer in the State of Georgia, describing the methods for shoring and sheeting of excavations. Shoring, including sheet piling, shall be furnished and installed as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Shoring, bracing, and sheeting shall be removed as excavations are backfilled, in a manner to prevent caving.

3.5 GRADING AREAS

Where indicated, work will be divided into grading areas within which satisfactory excavated material shall be placed in embankments, fills, and required backfills. The Contractor shall not haul satisfactory material excavated in one grading area to another grading area except when so directed in writing. Stockpiles of satisfactory and unsatisfactory and wasted materials shall be placed and graded as specified. Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times. The ground surface at stockpile locations shall be cleared, grubbed, and sealed by rubber-tired equipment, excavated satisfactory and

unsatisfactory materials shall be separately stockpiled. Stockpiles of satisfactory materials shall be protected from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, such material shall be removed and replaced with satisfactory material from approved sources.

3.6 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

Excavation to final grade shall not be made until just before concrete is to be placed. Only excavation methods that will leave the foundation rock in a solid and unshattered condition shall be used. Approximately level surfaces shall be roughened, and sloped surfaces shall be cut as indicated into rough steps or benches to provide a satisfactory bond. Shales shall be protected from slaking and all surfaces shall be protected from erosion resulting from ponding or flow of water.

3.7 SUBGRADE PREPARATION

3.7.1 General Requirements

Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials as directed by the Owner's representative. Where the in situ material passes proofrolling (stable) and is satisfactory, the surface shall be scarified to a depth of 6 inches before the fill is started. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When subgrades are less than the specified density, the ground surface shall be broken up to a minimum depth of 6 inches, pulverized, and compacted to the specified density. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches and compacted as specified for the adjacent fill.

3.7.2 Proof Rolling

Proof rolling shall be done on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. Proof roll the subgrade with six passes of a dump truck fully loaded with soil transferring a load in excess of 20 tons. Operate the truck in a systematic manner to ensure the number of passes over all areas, and at speeds between 2 1/2 to 3 1/2 mph. Notify the Owner a minimum of 3 days prior to proof rolling. Proof rolling shall be performed in the presence of the Owner's representative. Rutting or pumping of material shall constitute failure of subgrade. At the Contractor's expense, additional proof rolling may be requested by the Owner's Representative on any area that is deemed questionable.

A. In areas where the in situ material is satisfactory and passes proof roll (stable), the Contractor shall compact the top 12 inches of subgrade per Paragraph 3.6.4 "Compaction."

B. In areas where the in situ material is satisfactory but fails proof roll (unstable), the Contractor shall dry and compact the material to a depth necessary to achieve stability in the top 12 inches of subgrade. Excavation, stockpiling, drying and compaction of satisfactory material shall be performed at the Contractor's expense. See Paragraph 3.7.4 "Compaction" for compaction requirements.

C. In areas where the in situ material is unsatisfactory and fails proof roll (unstable), the Contractor shall undercut the unsatisfactory material to a depth of 18 inches below Top of Subgrade and replaced with compacted structural fill or #57 stone. The backfill material

shall be placed in lifts not to exceed 8 inches and rolled in with a static wheel roller, unless directed otherwise by the Owner's Representative. See Paragraph 3.7.4 "Compaction" for compaction requirements.

3.7.3 Construction

Subgrade shall be shaped to line, grade, and cross section, and compacted as specified. This operation shall include plowing, disking, and any moistening or aerating required to obtain specified compaction. Soft or otherwise unsatisfactory material shall be removed and replaced with satisfactory excavated material or other approved material as directed. Rock encountered in the cut section shall be excavated to a depth of 12 inches below finished grade for the subgrade. Low areas resulting from removal of unsatisfactory material or excavation of rock shall be brought up to required grade with satisfactory materials, and the entire subgrade shall be shaped to line, grade, and cross section and compacted as specified. The elevation of the finished subgrade shall not vary more than 0.05 foot from the established grade and cross section.

3.7.4 Compaction

Compaction shall be accomplished by pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. All material used as backfill shall be placed at optimum moisture content or within $\pm$3 percent of optimum moisture content. At a minimum, the top 18 inches of subgrade, or structural fill, shall be compacted to at least 98 percent of laboratory maximum density per ASTM D698. The remaining upper 5 feet shall be compacted to at least 95 percent of laboratory maximum density per ASTM D698. The remainder of the fill shall be compacted to at least 90 percent of laboratory maximum density per ASTM D698.

3.7.5 Frozen Material

Material shall not be placed on surfaces that are muddy, frozen, or contain frost. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Material shall be moistened or aerated as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Minimum subgrade density shall be as specified in paragraph TESTING.

3.8 UTILIZATION OF EXCAVATED MATERIALS

Unsatisfactory materials removed from excavations shall be removed from the site. Satisfactory material removed from excavations shall be used, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. No satisfactory excavated material shall be wasted without specific written authorization. Coarse rock from excavations may be stockpiled and used for constructing slopes or embankments adjacent to streams, or sides and bottoms of channels and for protecting against erosion, as approved by Owner. No excavated material shall be disposed of to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

3.9 BURIED TAPE AND DETECTION WIRE

3.9.1 Buried Warning and Identification Tape

Provide buried utility lines with utility identification tape. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.

3.9.2 Buried Detection Wire

Bury detection wire directly above non-metallic piping at a distance not to exceed 12 inches above the top of pipe. The wire shall extend continuously and unbroken, from manhole to manhole. The ends of the wire shall terminate inside the manholes at each end of the pipe, with a minimum of 3 feet of wire, coiled, remaining accessible in each manhole. The wire shall remain insulated over its entire length. The wire shall enter manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, the wire shall terminate in the valve pit at the pump station end of the pipe.

3.10 BACKFILLING AND COMPACTION

3.10.1 Backfilling with Structural Fill

Structural Fill should be placed over a stable or stabilized subgrade. Structural fills (or #57 stone) should be placed in thin (8 to 10 inch loose) lifts and compacted to specified density. Fill brought to the site should be within three percent (wet or dry) of the optimum moisture content. Some manipulation of the moisture content (such as wetting or drying) will be required during the filling operation to obtain the required degree of compaction. The manipulation of the moisture content is highly dependent on weather conditions and site drainage conditions. The Contractor should be prepared to both dry and wet fill materials to obtain the specified compaction during grading.

3.10.2 Backfill Adjacent to Structures

Backfill adjacent to any and all types of structures shall be placed and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials to prevent wedging action or eccentric loading upon or against the structure. Ground surface on which backfill is to be placed shall be prepared as specified in paragraph SUBGRADE PREPARATION. Compaction requirements for backfill materials shall also conform to the applicable portions of this paragraph and paragraphs SUBGRADE PREPARATION and EMBANKMENTS, and Section 02630 “Storm Drainage”

3.10.3 Compaction

Structural fills placed above the Top of Subgrade shall be compacted to at least 95% laboratory maximum density per ASTM D698. Compaction of structural fills (or #57 stone) shall be accomplished by heavy-duty vibratory roller or other approved equipment.

3.10.4 Trench Backfill

Trenches shall be backfilled to the grade shown. The trench shall only be backfilled to the spring line of the pipe until all specified tests are performed.

3.10.4.1 Replacement of Unyielding Material

Unyielding material removed from the bottom of the trench shall be replaced with structural fill or initial backfill material.

3.10.4.2 Replacement of Unstable Material

Unstable material removed from the bottom of the trench or excavation shall be replaced with structural fill placed in layers not exceeding 6 inches loose thickness.

3.10.4.3 Bedding and Initial Backfill

Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe. Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D 698 maximum density. Plastic piping shall have bedding to spring line of pipe. Provide coarse sands and gravels with maximum particle size of 1.5 inches, including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D 2487.

3.10.4.4 Final Backfill

The remainder of the trench, except for special materials for roadways, shall be filled with satisfactory material. Backfill material shall be placed and compacted as follows:

A. Roadways and Site: Backfill shall be placed up to the required elevation as specified. Water flooding or jetting methods of compaction will not be permitted.

3.10.5 Backfill for Appurtenances

After the manhole, catch basin, inlet, or similar structure has been constructed, backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as specified for final backfill, and shall be brought up evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.11 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.11.1 Water Lines

Trenches shall be of a depth to provide a minimum cover of 3 feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe.

3.11.2 Electrical Distribution System

Direct burial cable and conduit or duct line shall have a minimum cover of 24 inches from the finished grade, unless otherwise indicated.

3.12 EMBANKMENTS

3.12.1 Earth Embankments

Earth embankments shall be constructed from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 3 inches. The material shall be placed in successive horizontal layers of loose material not more than 8 inches in depth. Each layer shall be spread uniformly on a soil surface that has been moistened or aerated as necessary, and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed. After spreading, each layer shall be plowed, disked, or otherwise broken up; moistened or aerated as necessary; thoroughly mixed; and compacted to at least 90 percent laboratory maximum density for cohesive materials (where permitted), 95 percent laboratory maximum

density for cohesionless materials (general embankment fill), and 98 percent laboratory maximum density for structural fill (subgrade placed 5 feet below pavements or tracks). Compaction requirements for the upper portion of earth embankments forming subgrade for pavements shall be identical with those requirements specified in paragraph SUBGRADE PREPARATION. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.13 FINISHING

The surface of excavations, embankments, and subgrades shall be finished to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. The degree of finish for graded areas shall be within 0.1 foot of the grades and elevations indicated except that the degree of finish for subgrades shall be specified in paragraph SUBGRADE PREPARATION. Gutters and ditches shall be finished in a manner that will result in effective drainage. The surface of areas to be turfed shall be finished to a smoothness suitable for the application of turfing materials. Settlement or washing that occurs in graded, topsoiled, or backfilled areas prior to acceptance of the work, shall be repaired and grades re-established to the required elevations and slopes.

3.13.1 Subgrade and Embankments

During construction, embankments and excavations shall be kept shaped and drained. Ditches and drains along subgrade shall be maintained to drain effectively at all times. The finished subgrade shall not be disturbed by traffic or other operation and shall be protected and maintained by the Contractor in a satisfactory condition until ballast, subbase, base, or pavement is placed. The storage or stockpiling of materials on the finished subgrade will not be permitted. No subbase, base course, ballast, or pavement shall be laid until the subgrade has been checked and approved, and in no case shall subbase, base, surfacing, pavement, or ballast be placed on a muddy, spongy, or frozen subgrade.

3.13.2 Grading Around Structures

Areas within 5 feet outside of each building and structure line shall be constructed true-to-grade, shaped to drain, and shall be maintained free of trash and debris until final inspection has been completed and the work has been accepted.

3.14 TESTING

Testing shall be performed by an approved independent testing laboratory subject to approval. Field in-place density shall be determined in accordance with ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using only the sand cone method as described in ASTM D 1556. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017; the calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed by the Owner. When test results indicate, as determined by the Owner, that compaction is not as specified, the material shall be removed, replaced and recompacted to meet specification requirements. Tests on recompacted areas shall be performed to determine conformance with specification requirements. Inspections and test results shall be certified by a Registered Professional Civil Engineer in the State of Georgia. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the

appropriate time, will be the minimum acceptable for each type operation. All tests shall be submitted to the Owner's Representative within one working day of completion of the required test.

3.14.1 Fill and Backfill Material Gradation

One test per 500 cubic yards stockpiled or in-place source material. Gradation of fill and backfill material shall be determined in accordance with GDOT Section 812 or as indicated elsewhere in the Construction Documents.

3.14.2 In-Place Densities

A. One test per 500 square yards, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines.

B. One test per 300 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.

3.14.3 Check Tests on In-Place Densities

If ASTM D 2922 is used, in-place densities shall be checked by ASTM D 1556 as follows:

A. Two check tests per day.

3.14.4 Moisture Contents

In the stockpile, excavation, or borrow areas, a minimum of two tests per day per type of material or source of material being placed during stable weather conditions shall be performed. During unstable weather, tests shall be made as dictated by local conditions and approved by the Owner.

3.14.5 Optimum Moisture and Laboratory Maximum Density

Tests shall be made for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 300 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

3.14.6 Tolerance Tests for Subgrades

Continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION shall be made during construction of the subgrades.

3.14.7 Displacement of Sewers

After other required tests have been performed and the trench backfill compacted to the finished grade surface, the pipe shall be inspected to determine whether significant displacement has occurred. Pipe sizes larger than 36 inches shall be entered and examined, while smaller diameter pipe shall be inspected by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, the defects shall be remedied as directed at no additional cost to the Owner.

3.15 DISPOSITION OF SURPLUS MATERIAL

Surplus material or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber shall be removed and disposed of by the Contractor.

End of Section 31 00 00

SECTION 31 10 00

CLEARING AND GRUBBING

PART 1 - GENERAL

1.1 SUMMARY

Work under this section includes requirements for clearing and grubbing the project area as indicated on the drawings. The work of this section shall include, but not be limited to clearing and disposing of all trees, stumps, shrubbery growth, roots and other vegetation within the project limits, unless otherwise indicated. The Contractor shall furnish all labor, equipment and utilities to complete the work as indicated on the project drawings and as specified herein.

1.2 SITE CONDITIONS

The Contractor shall be responsible for visiting and examining the project site to assess the extent of clearing and grubbing work to be done.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 LIMITS OF SITE CLEARING AND GRUBBING

The Contractor shall perform site clearing to the limits of the work area shown on the drawings.

3.2 PROTECTION

3.2.1 Roads and Walkways

Keep roads and walkways free of dirt and debris at all times.

3.2.2 Trees, Shrubs, and Existing Facilities

Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require.

3.2.3 Utility Lines

Protect existing utility lines that are indicated to remain from damage. Notify the Owner immediately of damage to or an encounter with an unknown existing utility line. The Contractor shall be responsible for the repairs of damage to existing utility lines that are indicated or made known to the Contractor prior to start of clearing and grubbing operations. When utility lines which are to be removed are encountered within the area of operations, the Contractor shall notify the Owner in ample time to minimize interruption of the service.

3.3 CLEARING

Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including downed timber, snags, brush, and rubbish occurring within the areas to be cleared. Clearing shall also

include the removal and disposal of structures that obtrude, encroach upon, or otherwise obstruct the work. Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface.

3.4 TREE REMOVAL

Where indicated or directed, trees and stumps that are designated as trees shall be removed from areas outside those areas designated for clearing and grubbing. This work shall include the felling of such trees and the removal of their stumps and roots as specified in paragraph GRUBBING. Trees shall be disposed of as specified in paragraph DISPOSAL OF MATERIALS.

3.5 GRUBBING

Grubbing shall consist of the removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the designated grubbing areas. Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 18 inches below the original surface level of the ground in areas indicated to be grubbed and in areas indicated as construction areas under this contract, such as areas for buildings, and areas to be paved. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the original adjacent surface of the ground.

3.6 DISPOSAL OF MATERIALS

3.6.1 Saleable Timber

All timber on the project site noted for clearing and grubbing shall become the property of the Contractor, and shall be removed and disposed of off of the project site.

3.6.2 Nonsaleable Materials

Logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations shall be disposed of off of the project site at the Contractor's responsibility. The use of burning at the project site for the disposal of refuse and debris will not be permitted, unless allowed by local and State regulations and expressly approved by the Owner.

End of Section 31 10 00

SECTION 31 20 00 - EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating and filling for rough grading the Site.
2. Preparing subgrades for slabs-on-grade .
3. Excavating and backfilling for buildings and structures.
4. Drainage course for concrete slabs-on-grade.

1.2 DEFINITIONS

A. Backfill: Soil 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. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. 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.

I. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

J. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

K. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.3 PREINSTALLATION MEETINGS

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

1.4 INFORMATIONAL SUBMITTALS

A. Material test reports.

1.5 FIELD CONDITIONS

A. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth-moving operations.

B. Do not commence earth-moving operations until plant-protection measures specified in Section 01 56 39 "Temporary Tree and Plant Protection" are in place.

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: Soil Classification Groups GW, GP, GM, GC, SW, SP, SC, and SM according to ASTM D2487, 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.

1. Liquid Limit: 40 .
2. Plasticity Index: 25 .

C. Unsatisfactory Soils: Soil Classification Groups CL, ML, OL, CH, MH, OH, and PT according to ASTM D2487, 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. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 95 percent passing a 1-1/2-inch sieve and not more than 5 percent passing a No. 200 sieve.

F. Structural Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 25 percent passing a No. 200 sieve.

2.2 ACCESSORIES

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 earth-moving operations.

B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 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.

3.3 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within 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. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work. If unsuitable bearing soils are encountered at the base of the planned footing excavations, the excavation should be extended deeper to suitable soils, and the footings could bear directly on these soils at the lower lever or on lean concrete backfill plaed in the excavations.
2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

B. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Cut and protect roots according to requirements in Section 01 56 39 "Temporary Tree and Plant Protection."

3.4 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.5 SUBGRADE INSPECTION

A. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired dump truck to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.6 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

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.

3.8 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Initial Backfill: Place and compact initial backfill of , free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

D. Final Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.

E. Warning Tape: Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.9 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 structural fill.
4. Under building slabs, use structural fill.
5. Under footings and foundations, use #57 stone.

3.10 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.11 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.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D1557:

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 turf 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.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch .
2. Walks: Plus or minus 1 inch .
3. Pavements: Plus or minus 1/2 inch .

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.13 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:

1. Shape subbase course and base course to required crown elevations and cross-slope grades.
2. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
3. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D1557.

3.14 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:

1. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
2. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D698.

3.15 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform inspections:

B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.16 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.

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.

END OF SECTION 31 20 00

SECTION 31 25 00GA

EROSION AND SEDIMENTATION CONTROLS (GA)

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Appendix “A” – Notice of Intent

Appendix “B” – Notice of Termination

Appendix “C” – General Permit No. GAR100001 – Stand Alone

Appendix “D” – Suggested Monitoring and Report Forms

SECTION 31 25 00GA

EROSION AND SEDIMENTATION CONTROLS (GA)

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Soil erosion, sediment, and pollution control measures shall include all temporary and permanent means of soil protection, trapping soils and containment of pollutants on the construction site during land disturbing activities. Activities covered in this section are regulated by the Manual for Erosion and Sediment Control in Georgia (latest revision) and Georgia's National Pollutant Discharge Elimination System Permit (NPDES), General Permit No. GAR100001

B. Reporting

C. Sampling

1.2 RELATED SECTIONS

A. Section 31 00 00 – Earthwork

B. Section 31 10 00 – Clearing & Grubbing

1.3 PURPOSES

A. The purpose of this section is to achieve the following goals:

1. Minimize soil exposure by proper timing of clearing grading and construction.

2. Retain existing vegetation whenever feasible.

3. Vegetate and mulch disturbed areas as soon as possible.

4. Divert runoff away from disturbed areas.

5. Minimize length and steepness of slopes when it is practical.

6. Reduce runoff velocities with check dams or surface roughing.

7. Trap sediment on site.

8. Inspect and maintain erosion, sedimentation, and pollution control measures.

9. Report on condition of Best Management Practices (BMPs).

10. Sample site run off per Georgia's NPDES Permit.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of soil erosion, sedimentation and pollution control systems products of types, materials, and sizes

required, whose products have been in satisfactory use in similar service for not less than 5 years.

Codes and Standards: Comply with all applicable Local, State, and Federal Standards pertaining to soil erosion, sedimentation, and pollution control.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instruction for soil erosion, sedimentation and pollution control materials and products.

PART 2 – PRODUCTS

2.1 VEGETATIVE MATERIALS

A. Mulch

1. Dry straw or hay.
2. Wood chips, sawdust or bark.
3. Cutback asphalt.

B. Temporary Seeding

1. Annual Ryegrass
2. Browntop Millet

C. Permanent Seeding

1. Common Bermuda
2. Centipede

D. Sod

1. Common Bermuda
2. Centipede
3. St. Augustine

E. Fertilizer

1. Commercial 6–12–12

2.2 STRUCTURAL MATERIALS

A. Check Dam

1. Stone (2” – 10”)

2. Bales of densely baled hay or straw wrapped with synthetic or wire bands (two minimum per bale).

B. Construction Exit

1. Minimum 20’ x 50’ x 0.5’ layer of 1.5” to 3.5” stone with a geotextile underliner.

C. Filter Ring

1. Minimum 2’ high stone ring. Stone shall be no smaller than 3” to 5” when utilized at storm drain inlets and pond outlets with pipe diameters less than 12”.

2. Minimum 2’ high stone ring. Stone shall be no smaller than 10” to 15” when utilized at storm drain inlets and pond outlets with pipe diameters greater than 12”.

D. Sediment Barrier

1. Bales of densely baled hay or straw wrapped with synthetic or wire bands (two minimum per bale).

2. Silt Fence – Shall be a woven geotextile fabric sheet of plastic yarn composed of a long chain synthetic polymer with at least 85% by weight propylene, ethylene, amide, ester or vinylidene chloride, and shall contain stabilizers and/or inhibitors added to the base plastic to make the filaments resistant to deterioration due to ultra–violet and/or heat exposure. The fabric shall be finished so the filaments will retain their relative position with respect to each other. The fabric shall be free of defects, rips, holes, or flaws. The manufacturer shall have either an approved color mark yarn in the fabric or label the fabricated silt fence with both the manufacturer and fabric name every 100’.

The fabric shall meet the following requirements:

Grab Strength	90 lbs.
Mullen Burst Strength	150 lbs.
UV Resistance	80 %

E. Inlet Sediment Trap

1. Silt fence (Type C) supported by steel posts.

2. Baffle Box – Constructed of 2” x 4” boards spaced a maximum of 1” apart or plywood with weep holes 2” in diameter (See detail).

3. Sod Inlet Protection – Four – 1 foot wide strips of sod on each side of the inlet (See detail).

4. Curb Inlet Protection – Eight inch concrete blocks wrapped in filter fabric, placed in front of a curb inlet.

F. Storm Drain Outlet Protection

1. Geotextile fabric equivalent to Mirafi 140N.

2. Rip–rap (See detail for size).

2.3 CHEMICAL MATERIALS

A. Dust Control – Calcium Chloride, Anionic Asphalt Emulsion, Latex Emulsion, or Resin–in–Water Emulsion.

B. Anionic Polyacrylamide (PAM) – Consult state and local laws concerning the regulations of this chemical.

PART 3 – EXECUTION

3.1 GENERAL

A. All disturbed soil areas except those to support paving shall be graded and protected from erosion with vegetative materials. Sedimentation discharge from the construction site into natural drainage ways and storm drainage systems shall be prevented by means of vegetative measures and temporary structural practices. These vegetative measures and structural practices are known as Best Management Practices (BMPs). Rainfall, pollution control measures, and construction exit condition shall be monitored and reported on each day when construction activities take place. Erosion and sedimentation control measures shall be monitored and reported on every seven days and within 24 hours of a qualifying rainfall event of 0.5 inches or more. Sampling of construction site discharging water shall be sampled within 45 minutes of a qualifying rainfall event and analyzed immediately or no later than 48 hours after collection. The above reports shall be submitted to the Georgia EPD by the fifteenth day of the month following the reporting period.

B. The Contractor (Operator) is considered a “Primary Permittee” and shall submit a Notice of Intent (NOI) in accordance with General Permit No. GAR100001, at least 14 days prior to the commencement of construction activities. Contractor shall retain a copy of the Erosion, Sedimentation, and Pollution Control Plan and Comprehensive Monitoring Program required by above permit at construction site or be readily available at a designated alternate location from date of project initiation to date of final stabilization. Copies of all Notice of Intent, Notice of Termination, plans, monitoring reports and all other records required by above permit shall be retained by Contractor for a period of at least three years from date the site is finally stabilized. Copies of Notice of Intent (NOI), Notice of Termination (NOT) and General Permit Number GAR100001 are found at the end of this section.

3.2 ON–SITE OBSERVATION

A. Engineer is required by General Permit No. GAR100001 to check the installation of Erosion, Sedimentation and Pollution Control measures within one week after initial construction activities commence. The Contractor shall notify Engineer within 24 hours of control measures installation for the above site visit. Engineer, within the above parameters, shall check subsequent installation of control measures.

3.3 VEGETATIVE PRACTICES

A. Mulch

1. Dry straw or hay shall be applied at a depth of 2 to 4 inches by hand or mechanical equipment providing complete soil coverage. Straw or hay shall be

anchored immediately after application. Straw or hay can be anchored with a disk harrow, packer disk or emulsified asphalt.

2. Wood chips, sawdust, or bark shall be applied at a depth of 2 to 3 inches by hand or mechanical equipment providing complete soil coverage. Netting of the appropriate size shall be used to anchor the above materials.

3. Cutback asphalt shall be applied at 1,200 gallons per acre or 1/4 gallon per square yard.

B. Seeding

1. Seed shall be applied uniformly by hand, cyclone seeder, drill, cultipacker seeder, or hydraulic seeder. Drill or cultipacker seeders shall place seed 1/4" to 1/2" deep. Soil shall be raked lightly to cover seed with soil if seeded by hand.

2. During times of drought, water shall be applied at a rate not causing runoff and erosion. The soil shall be thoroughly wetted to depth insuring germination of the seed. Subsequent applications of water shall be made when needed.

C. Sodding

1. Bring soil surface to final grade. Clear surface of trash, woody debris stones, and dirt clods larger than 1". Mix fertilizer into soil surface. Apply sod to soil when surface is not muddy or frozen. Lay sod with tight joints and in straight lines. Do not overlap joints. Stagger joints and do not stretch sod. On slopes steeper than 3:1, sod shall be anchored with pins or other approved methods. Installed sod shall be rolled or tamped to provide good contact between sod and soil. Irrigate sod and soil to a depth of 4" immediately after installation. Irrigation shall be used to supplement rainfall for a minimum of 2–3 weeks.

3.4 STRUCTURAL MEASURES

A. Check Dam

1. Stone – Shall be constructed of graded size 2–10 inch stone underlayed with a geotextile fabric. Mechanical or hand placement shall be required to insure complete coverage of entire width of ditch or swale and center of dam is lower than edges. Sediment shall be removed when it reaches a depth of one–half the original dam height or before.

2. Haybale – Shall be staked and embedded a minimum of 4" and may be used as temporary check dams in concentrated flow areas while vegetation is becoming established. They should not be used where the drainage area exceeds one acre. Sediment shall be removed when it reaches a depth of one–half the original dam height or before.

B. Construction Exit

1. A stone stabilized pad shall be located at any point where traffic will be leaving the construction site to a public right–of–way, street, alley, sidewalk, parking area or any other area where there is a transition from bare soil to a paved area. The pad shall be constructed of 1.5" to 3.5" stone, having a minimum thickness of 6" and not less than 20' wide and 50' long. The pad shall be underlayed with a geotextile fabric. The pad shall be maintained in a condition, which will prevent

tracking or flow of mud onto public rights–of–way. This may require periodic top dressing with 1.5" to 3.5" stone. All materials spilled, dropped, washed, or tracked from vehicles or site onto roadways or into storm drains must be removed immediately.

C. Filter Ring

1. Shall surround all sides of the structure receiving runoff from disturbed areas. It shall be placed a minimum of 4' from the structure. It may also be used below storm drains discharging into detention ponds, creating a centralized area for sediment accumulation. When utilized below a storm drain outlet, it shall be placed such that it does not create a condition causing water to back–up into the storm drain and inhibit the function of the storm drain system. The larger stone can be faced with smaller filter stone on the upstream side for added sediment filtering capabilities. Mechanical or hand placement of stone shall be required to uniformly surround the structure.

2. Filter ring must be kept clear of trash and debris. This requires continuous monitoring and maintenance, which includes sediment removal when one–half full. Filter rings are temporary and should be removed when the site has been stabilized.

D. Sediment Barrier

1. Hay or straw bales may be used in areas of low sheet flow rates. They shall not be use if the project duration is expected to exceed three months. Bales shall be placed in a single row, lengthwise, and embedded in the soil to a depth of 4". Bales must be securely anchored in place by stakes or bars driven through the bales or by other acceptable means to prevent displacement. Bales shall be placed so the binding wire or twine around the bale will not touch the soil. Sediment shall be removed once it has accumulated to one–half the original height of the barrier. Barriers shall remain in place until disturbed areas have been permanently stabilized. All sediment accumulated at the barrier shall be removed and properly disposed of before the barrier is removed. The slope lengths contributing runoff to a bale barrier cannot exceed those listed below.

Land Slope (Percent)	Maximum Slope Length Above Bale (Feet)
< 2	75
2 to 5	50
5 to 10	35
10 to 20	20
> 20	10

2. Silt fence may be used in areas of higher sheet flow rates. The drainage area shall not exceed ¼ acre for every 100' of silt fence. **Silt fence shall not be installed across streams, ditches, waterways or other concentrated flow areas.** Silt fence shall be installed according to this specification, as shown on the construction drawings or as directed by the Engineer. See details on the construction drawings for installation requirements.

   a. Type A – A 36" wide filter fabric silt fence shall be used on construction sites where the life of the project is greater than or equal to six months.

b. Type B – A 22” wide filter fabric silt fence shall be limited to use on minor projects, such as residential home sites or small commercial developments where permanent stabilization will be achieved in less than six months.

c. Type C – A 36” wide filter fabric silt fence with wire reinforcement shall be used where runoff flows or velocities are particularly high or where slopes exceed a vertical height of 10’. Along stream buffers and other sensitive areas, two rows of Type C silt fence or one row of Type C silt fence backed by hay bales shall be used.

3. Where all runoff is to be stored behind the silt fence (where no stormwater disposal system is present), the slope lengths contributing runoff to a silt fence barrier cannot exceed those listed below.

Land Slope (Percent)	Maximum Slope Length Above Fence (Feet)
< 2	100
2 to 5	75
5 to 10	50
10 to 20	25
> 20*	15

*In areas where the slope is greater than 20%, a flat area length of 10’ between the toe of the slope and the fence shall be provided.

4. Sediment shall be removed once it has accumulated to one–half the original height of the barrier. Filter fabric shall be replaced whenever it has deteriorated to such an extent that the effectiveness of the fabric is reduced (approximately six months). Barriers shall remain in place until disturbed areas have been permanently stabilized. All sediment accumulated at the barrier shall be removed and properly disposed of before the barrier is removed.

E. Inlet Sediment Trap

1. Shall be installed at or around all storm drain inlets receiving runoff from disturbed areas. Sediment traps must be self draining unless they are otherwise protected in an approved manner that will not present a safety hazard. The drainage area entering the inlet sediment trap shall be no greater than one acre. Sediment traps may be constructed on natural ground surface, on an excavated surface or on machine compacted fill provided they have a non–erodible outlet.

2. Type C silt fence supported by steel posts may be used where the inlet drains a relatively flat area (slope no greater than 5%) and shall not apply to inlets receiving concentrated flows, such as in street or highway medians. The stakes shall be spaced evenly around the perimeter of the inlet a maximum of 3’ apart and securely driven into the ground, approximately 18" deep. The fabric shall be entrenched 12" and backfilled with crushed stone or compacted soil. Fabric and wire shall be securely fastened to the posts and fabric ends must be overlapped a minimum of 18” or wrapped together around a post to provide a continuous fabric barrier around the inlet. The trap shall be inspected daily and after each rain. Repairs are to be made as needed. Sediment shall be removed once it has

accumulated to one–half the height of the trap. **Sediment shall not be washed into the inlet.** It shall be removed from the sediment trap and disposed of and stabilized so it will not enter the inlet again. When the contributing drainage area has been permanently stabilized, all materials and any sediment shall be removed and either salvaged or disposed of properly. The disturbed area shall be brought to proper grade, smoothed and compacted. Appropriately stabilize all disturbed areas around the inlet.

3. A baffle box shall be used for inlets receiving runoff with a higher volume or velocity. The box shall be constructed of 2" x 4" boards spaced a maximum of 1" apart or of plywood with weep holes 2" in diameter. The weep holes shall be placed approximately 6" on center vertically and horizontally. The entire box shall be wrapped in Type C filter fabric that is entrenched 12" and backfilled. Gravel shall be placed around the box to a depth of 2" to 4". The trap shall be inspected daily and after each rain. Repairs are to be made as needed. Sediment shall be removed once it has accumulated to one–half the height of the trap. **Sediment shall not be washed into the inlet.** It shall be removed from the sediment trap and disposed of and stabilized so it will not enter the inlet again. When the contributing drainage area has been permanently stabilized, all materials and any sediment shall be removed and either salvaged or disposed of properly. The disturbed area shall be brought to proper grade, smoothed and compacted. Appropriately stabilize all disturbed areas around the inlet.

4. Sod Inlet Protection shall be used only at the time of permanent seeding, to protect the inlet from sediment and mulch material until permanent vegetation has become established. The sod shall be place to form a turf mat covering the soil for a distance of 4' from each side of the inlet structure. Sod strips shall be staggered so adjacent strip ends are not aligned. Re–sod areas where an adequate stand of sod is not obtained. New sod should be mowed sparingly. Grass height should not be less than 2" to 3".

5. Curb Inlet Protection shall be used on curb inlets receiving runoff from disturbed areas once pavement has been installed. Place 8" concrete blocks wrapped in filter fabric in front of the curb inlet opening. A gap of approximately 4" shall be left between the inlet filter and the inlet to allow for overflow and prevention of hazardous ponding in the roadway. **This method of inlet protection shall be removed if a safety hazard is created.** Sediment shall be removed from curb inlet protection immediately.

F. Storm Drain Outlet Protection

1. Outlet protection aprons shall be constructed at all storm drain outlets, road culverts, paved channel outlets discharging into natural or constructed channels. Apron will extend from end of the conduit, channel, or structure to the point of entry into an existing stream or publicly maintained drainage system. Apron length, width, and stone size shall conform to details on the construction drawings. Apron shall be constructed with no slope along its length. Invert elevation of the downstream end of apron shall be equal to the elevation of the receiving channel invert. There shall be no overfall at the end of apron. Apron shall be located so there are no bends in the horizontal alignment.

2. Subgrade for geotextile fabric and rip–rap shall follow required lines and grades shown on the construction drawings. Compact any subgrade fill required to the density of surrounding undisturbed material. Low areas in subgrade on undisturbed soil may also be filled by increasing rip–rap thickness. Geotextile

fabric shall be protected from punching or tearing during installation. Repair any damage by removing rip–rap and placing another piece of fabric over the damaged area. All connecting joints shall overlap a minimum of 1'. If damage is extensive, replace entire geotextile fabric. Rip–rap shall be placed by equipment or hand. Minimum thickness of rip–rap shall be 1.5 times the maximum stone diameter. Immediately after construction, stabilize all disturbed areas around apron with vegetation.

3. Check outlet apron after heavy rains to see if any erosion around or below the rip–rap has taken or if stones have been dislodged. Immediately make all needed repairs to prevent further damage.

3.5 CHEMICAL MEASURES

A. Dust Control

1. Dust raised from vehicular traffic shall be controlled by wetting down roads with water or by the use of chemicals. Chemicals shall be applied in accordance with the manufacturer's recommendations.

B. Soil Binding

1. This temporary practice is intended for direct soil surface application to sites where the timely establishment of vegetation may not be feasible or where vegetative cover is absent or inadequate. **This temporary practice is not intended for application to surface waters of the state.** It is intended for application within construction storm water ditches and storm drains that feed into previously constructed sediment ponds or basins.

2. Anionic Polyacrylamide (PAM) is available in emulsions, powders, gel bars, and logs. It is required that other Best Management Practices be used in combination with anionic PAM. The use of seed and mulch for additional erosion protection beyond the life of anionic PAM is recommended. Use 50' setbacks when applying anionic PAM near natural water bodies. Never add water to PAM, add PAM slowly to water. If water is added to PAM, globs can form which can clog dispensers. This signifies incomplete dissolving of PAM and therefore increases the risk of under application. Application rates shall conform to manufacturer's guidelines. **The maximum application rate of PAM, in pure form, shall not exceed 200pounds/acre/year.** Contractors using anionic PAM shall obtain and follow all Material Safety Data Sheet requirements and manufacturer's recommendations. Gel bars and logs of anionic PAM mixtures may be used in ditch systems. This application shall meet the same testing requirements as anionic PAM emulsions and powders. Maintenance will consist of reapplying anionic PAM to disturbed areas, including high traffic areas, which interfere in the performance of this practice.

3.6 MONITORING AND REPORTING

A. Each day, when any type of construction activity takes place on the construction site, Contractor's qualified personnel shall monitor and record rainfall, inspect all areas where petroleum products are stored, used or handled for spills and leaks from vehicles and equipment and check all locations where vehicles enter or exit the site for evidence of off site sediment tracking. These inspections shall be conducted until a Notice of Termination (NOT) is submitted. For linear construction where a phased activity is conducted, this paragraph applies to the active phase(s) of work.

B. Once every seven calendar days and within 24 hours of the end of a storm 0.5 inches or greater, Contractor's qualified personnel shall inspect disturbed areas of the construction site that have not undergone final stabilization, areas used for storage of materials that are exposed to precipitation that have not undergone final stabilization and structural control measures (BMPs). Erosion and sediment control measures identified in the Erosion, Sedimentation, and Pollution Control Plan shall be observed to ensure they are operating correctly. Where discharge locations or points are accessible, they shall be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving water(s). These inspections must be conducted until a Notice of Termination is submitted. For linear construction where a phase activity is conducted, this paragraph applies to the active phase(s) of work.

C. Contractor's qualified personnel shall inspect a least once per month during the term of the General Permit, areas of the construction site having undergone final stabilization. These areas hall be inspected for evidence of, or the potential for, pollutants entering the drainage system and receiving water(s). Erosion and sediment control measure shall be observed to ensure they are operating correctly. Where discharge locations or points are accessible, they shall be inspected to ascertain whether erosion control measure are effective in preventing significant impacts to receiving water(s). For linear construction, monthly inspections in accordance with this paragraph shall be made for those phases on which final stabilization has been completed.

D. Contractor shall prepare a report summarizing the scope of inspections, name(s) of qualified personnel making the inspections, date(s) of inspections, major observations relating to the implementation of the Erosion, Sedimentation and Pollution Control Plan and any actions taken. This report shall be retained on the construction site or be readily available at a designated alternate location until the entire site or portion of a construction project that was phased, has undergone final stabilization and a Notice of Termination (NOT) is submitted to EPD. Such reports shall identify any incidents of non–compliance. Where the report does not identify any incidents of non–compliance, the re report shall contain a certification that the facility is in compliance with the Erosion, Sedimentation and Pollution Control Plan and the General Permit. The report shall be signed in accordance with the General Permit.

3.7 SAMPLING AND ANALYSIS

A. Contractor must manually or automatically sample in accordance with the Comprehensive Monitoring Plan (CMP) at least once for each rainfall event described below. For a qualifying event, samples must be taken within forty–five (45) minutes of:

1. The accumulation of the minimum amount of rainfall, if the storm water discharge to a monitored receiving water or from a monitored outfall has begun at or prior to the accumulation.

2. The beginning of any storm water discharge to a monitored receiving water or from a monitored outfall, if the discharge begins after the accumulation of the minimum amount of rainfall.

However, where manual and automatic sampling are impossible (as defined in the permit), or are beyond the Contractor's control, the Contractor shall take samples as soon as possible, but in no case more than 12 hours after the beginning of the storm water discharge.

B. Sampling shall occur for the following events:

1. For each area of the site discharging to a receiving stream, the first rain event reaching or exceeding 0.5 inch and allows for monitoring during normal business hours* (Monday thru Friday, 8:00 a.m. to 5:00 p.m. and Saturday 8:00 a.m. to 5:00 p.m. when construction activity is being conducted by the Primary permittee) occurring after all clearing and grubbing operations are completed in the drainage area of the location selected as the sampling location;

2. In addition to (1) above, for each area of the site discharging to a receiving stream, the first rain event reaching or exceeding 0.5 inch and allows for monitoring during normal business hours* occurring either 90 days after the first sampling event or after all mass grading operations are completed in the drainage area of the location selected as the sampling location, whichever comes first.

3. At the time of the sampling performed pursuant to (1) and (2) above, if BMPs are found to be properly designed, installed, and maintained, no further action is required. If BMPs in any area of the site discharging to a receiving stream are not properly designed, installed, and maintained, corrective action shall be defined and implemented within two business days, and turbidity samples shall be taken from discharges of the same area for each subsequent rain event reaching or exceeding 0.5 inch during normal business hours* until the selected turbidity standard is attained, or until post–storm event inspections determine BMPs are properly designed, installed, and maintained;

4. Existing construction activities, i.e., those occurring on or before the effective date of this permit, having met the sampling required by (1) above shall sample in accordance with (2). Those existing construction activities having met the sampling required by (2) above shall not be required to conduct additional sampling other than as required by (3) above.

   * Note the Permittee may choose to meet the requirements of (1) and (2) above by collecting turbidity samples from any rain event reaching or exceeding 0.5 inch and allows for monitoring at any time of the day or week.

5. For linear construction, if at any time during the life of the project, BMPs have not been properly designed, installed or maintained for the construction activities that discharge into a receiving water which is not being sampled, the Contractor shall sample that receiving water for the first rainfall event greater than or equal to 0.5 inches thereafter and for every rainfall event greater than or equal to 0.5 inches until BMPs are properly designed, installed and maintained.

C. Sampling shall be collected by “grab samples” and the analysis of these samples must be conducted in accordance with methodology and test procedures established in the General Permit. Sample containers shall be labeled prior to collecting the samples. Samples shall be well mixed before transferring to a secondary container. Large mouth, well cleaned and rinsed glass or plastic jars shall be used for collecting samples. The jars shall be cleaned thoroughly to avoid contamination. Manual or automatic sampling shall be utilized. Samples required by the General Permit shall be analyzed immediately, but in no case later than 48 hours after collection. However, samples from automatic samplers must be collected no later than the next business day after their accumulation, unless flow through automated analysis is utilized. Samples are not required to be cooled. Samples taken for the purpose of compliance with the General Permit shall be representative of the monitored activity and representative of the water quality of the receiving water(s) and/or the storm water outfalls using the following minimum guidelines:

1. The upstream sample for each receiving water(s) must be taken immediately upstream of the confluence of the first storm water discharge from the permitted construction site but downstream of any other storm water discharges not associated with the site. Where appropriate, several upstream samples from across the receiving water(s) may need to be taken and the average turbidity of these samples used for an upstream turbidity value.

2. The downstream sample for each receiving water(s) must be taken downstream of the confluence of the last storm water discharge from the construction site but upstream of any other storm water discharge not associated with the site. Where appropriate, several downstream samples from across the receiving water(s) may need to be taken and the average turbidity of these samples used for a downstream turbidity value.

3. Samples shall be taken from the horizontal and vertical center of the receiving water(s) or the storm water outfall channel(s).

4. Care shall be taken to avoid stirring the bottom sediments in the receiving water(s) or in the outfall storm water channel(s).

5. Sampling container shall be held so the opening faces upstream.

6. Samples shall be kept from floating debris.

D. For all construction sites and common developments other than linear construction projects, the Contractor shall sample all receiving water(s), or all outfall(s) or a combination of receiving water(s) and outfall(s). For linear construction projects, the Contractor must sample all perennial and intermittent streams and other water bodies shown on an USGS topographic map and all other field verified perennial and intermittent streams and other water bodies, or all outfalls into such streams and other water bodies, or a combination thereof.

E. Contractor shall provide and implement all safety equipment and procedures necessary for sampling during hazardous weather conditions and in the event of biological, chemical or physical hazards

F. Contractor shall submit a summary of the monitoring results to the EPD at the address shown in the General Permit by the fifteenth day of the month following the reporting period. For a monitoring period during which no qualifying rainfall events occur, a monitoring report must be submitted stating such. Monitoring periods are calendar months beginning with the first month after the effective date of the General Permit. Monitoring reports shall be signed in accordance with the General Permit and submitted to EPD until such time as a NOT is submitted.

G. Contractor must retain copies of all monitoring results and monitoring information reported. In addition to other record keeping requirements, the monitoring information shall include:

1. Date, exact place, and time of sampling or measurements.

2. Name(s) of the individual(s) who performed the sampling and measurements.

3. Date(s) analyses were performed.

4. Time(s) analyses were initiated.

5. Name(s) of the individual(s) who performed the analyses.

6. References and written procedures, when available, for the analytical techniques or methods used. A quality control/quality assurance program must be included in the written procedures.

7. The results of such analyses, including the bench sheets, instrument readouts, computer disks or tapes, used to determine these results.

8. Results exceeding 1,000 NTU shall be reported as “Exceeds 1,000 NTU.”

H. Suggested monitoring and report forms are found at the end of this section.

END OF SECTION 31 25 00 GA

SECTION 31 31 16 - TERMITE CONTROL

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. Soil treatment.

1.3 PREINSTALLATION MEETINGS

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components, and profiles for termite control products.
2. Include the EPA-Registered Label for termiticide products.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Certificates: For each type of termite control product.

C. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's records and include the following:

1. Date and time of application.
2. Moisture content of soil before application.
3. Termiticide brand name and manufacturer.
4. Quantity of undiluted termiticide used.
5. Dilutions, methods, volumes used, and rates of application.
6. Areas of application.
7. Water source for application.

D. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located.

1.7 FIELD CONDITIONS

A. Soil Treatment:

1. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.
2. Related Work: Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

1.8 WARRANTY

A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work consisting of applied soil termiticide treatment will prevent infestation of subterranean termites, including Formosan termites (Coptotermes formosanus). If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.

1. Warranty Period: Five years from date of Material Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain termite control products from single source.

2.2 SOIL TREATMENT

A. Termiticide: EPA-Registered termiticide acceptable to authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation.

1. Service Life of Treatment: Soil treatment termiticide that is effective for not less than five years against infestation of subterranean termites.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.

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

3.2 PREPARATION

A. General: Prepare work areas according to the requirements of authorities having jurisdiction and according to manufacturer's written instructions before beginning application and installation of termite control treatment(s). Remove extraneous sources of wood cellulose and other edible materials, such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.

B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated, except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.

1. Fit filling hose connected to water source at the site with a backflow preventer, according to requirements of authorities having jurisdiction.

3.3 APPLYING SOIL TREATMENT

A. Application: Mix soil treatment termiticide solution to a uniform consistency. Distribute treatment uniformly. Apply treatment at the product's EPA-Registered Label volume and rate for maximum specified concentration of termiticide to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction.

1. Slabs-on-Grade and Basement Slabs: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
2. Foundations: Soil adjacent to and along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing.
3. Crawlspaces: Soil under and adjacent to foundations. Treat adjacent areas, including around entrance platform, porches, and equipment bases. Apply overall treatment only where attached concrete platform and porches are on fill or ground.
4. Masonry: Treat voids.

5. Penetrations: At expansion joints, control joints, and areas where slabs and below-grade walls will be penetrated.

B. Post warning signs in areas of application.

C. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

3.4 PROTECTION

A. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.

B. Protect termiticide solution dispersed in treated soils and fills from being diluted by exposure to water spillage or weather until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

3.5 MAINTENANCE SERVICE

A. Maintenance Service: Beginning at Material Completion, maintenance service shall include 12 months' full maintenance by skilled employees of termite-control-treatment Installer. Include quarterly maintenance as required for proper performance according to the product's EPA-Registered Label and manufacturer's written instructions. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

B. Continuing Maintenance Proposal: Provide from termite-control-treatment Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1. Include annual inspection for termite activity and effectiveness of termite treatment according to manufacturer's written instructions.

END OF SECTION 31 31 16

SECTION 31 37 00

RIP–RAP

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SECTION 31 37 00

RIP–RAP

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Material placed as bank protection and erosion control.

1.2 RELATED SECTIONS

A. Section 31 25 00 (GA) – Erosion and Sedimentation Controls (GA)

1.3 ALLOWABLE TOLERANCES

A. Depth of rip–rap blanket as shown on the drawings and in these specifications, is a minimum depth.

1.4 OMITTED

1.5 REFERENCES (LATEST REVISION)

A. ASTM C 150 – Portland Cement.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Stone Rip–Rap: Shall be hard quarry or field stone of such quality the pieces will not disintegrate on exposure to water, sunlight, or weather. Stone shall be solid and non–friable and range in weight from a minimum of 25 pounds to a maximum of 150 pounds. At least 50 percent of the stone pieces shall weigh more than 60 pounds. The stone pieces shall have a minimum dimension of 12 inches. Documents indicating stone analysis, source and other pertinent data (i.e. – filter fabric) shall be submitted for review by the Engineer prior to delivery.

B. Sand–Cement Bag Rip–Rap:

1. Bags: Shall be of cotton, burlap, or fiber–reinforced paper capable of containing the sand–cement mixture without leakage during handling and placing. Bags previously used for any purpose shall not be used. Capacity shall be not less than 0.75 cubic foot nor more than two cubic feet.

2. Cement: Portland cement shall be Type I meeting requirements of ASTM C 150. Cement which has been damaged, or which is partially set, lumpy, or caked shall not be used.

3. Fine Aggregate: Shall be composed of hard, durable particles, free from injurious amounts of organic impurities and shall contain, in the material passing the No.

10 sieve, not more than 7 percent clay, and not more than 20 percent passing the No. 200 sieve.

C. Filter Fabric: Shall be a woven fabric of monofilament and multifilament yarn equivalent to Mirafi FW700. Fabric shall be finished so the filaments will retain their relative position with respect to each other. Fabric shall contain stabilizers and/or inhibitors added to make filaments resistant to deterioration due to ultraviolet and/or heat exposure. Fabric shall be free of flaws, rips, holes, or defects.

2.2 PRODUCT REVIEW

A. Contractor shall provide the Engineer with a complete description of all products before ordering. Engineer will review all products before they are ordered.

PART 3 – EXECUTION

3.1 PREPARATION

A. The surface to receive rip–rap shall be prepared to a relatively smooth condition free of obstruction, depressions, debris, rises, and soft or low density pockets of material. Contours and elevations on construction drawings are to the surface of rip–rap material.

3.2 PLACEMENT

A. Filter fabric shall be placed with the long dimension running up slope. The strips shall be placed to provide a minimum width of one foot of overlap for each joint. Fabric shall be anchored in place with securing pins of the type recommended by fabric manufacturer. Pins shall be placed on or within 3 inches of the over–lap. Place fabric so upstream strip will overlap the downstream strip. Fabric shall be placed loosely to give and avoid stretching and tearing during placement of the stones.

B. Minimum depth or thickness of stone blanket shall be 12 inches with no under tolerance. Stones shall be dropped no more than three feet during construction. Placing shall begin at bottom of slope. Provide a toe trench if required as detailed on the construction drawings. Entire mass of stone shall be placed to conform with lines, grades, and thickness shown on the plans. Rip–rap shall be placed to its full course thickness at one operation and in such a manner as to avoid displacing the underlying material. Placing of rip–rap in layers, or by dumping into chutes, or by similar methods likely to cause segregation, will not be permitted.

Larger stones shall be well distributed and the entire mass of stone shall conform to gradation specified. All material used in rip–rap protection shall be placed and distributed so there will be no large accumulations of either the larger or smaller sizes of stone.

It is the intent of these specifications to produce a fairly compact rip–rap protection in which all sizes of material are placed in their proper proportions. Hand placing or rearranging of individual stones by mechanical equipment may be required to secure the results specified.

C. Sand–Cement Bag Rip–Rap: Bags shall be uniformly filled. Bagged rip–rap shall be placed by hand with tied ends facing the same direction, with close, broken joints. After

placing, bags shall be rammed or packed against one another to produce the required thickness and form a consolidated mass. The top of each bag shall not vary more than 3 inches above or below required plane. When directed by the Engineer or required by construction drawings, header courses shall be placed.

END OF SECTION 31 37 00

SECTION 32 11 23

AGGREGATE BASE COURSES

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SECTION 32 11 23

AGGREGATE BASE COURSES

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Aggregate base course.

1.2 RELATED SECTIONS

A. Section 31 00 00 – Earthwork

B. Section 32 12 16GA – Asphalt Paving

1.3 OMITTED

1.4 REFERENCES (LATEST REVISION)

A. ASTM C 131 – Resistance to Degradation of Small–Size Course Aggregate by Abrasion and Impact in the Lost Angeles Machine.

B. ASTM D 1557 – Laboratory Compaction Characteristics of Soil Using Modified Effort.

C. ASTM D 6938 – In–Place Density and Water Content of Soil and Soil–Aggregate by Nuclear Methods (Shallow Depth).

D. ASTM D 3740 – Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock Used in Engineering Design and Construction.

E. ASTM E 329 – Agencies Engaged in Construction Inspection and/or Testing.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with the Georgia Department of Transportation Standard Specifications Construction of Transportation Systems, 2001 Edition.

1.6 TESTING

A. Laboratory tests for moisture density relationship for fill materials shall be in accordance with ASTM D 1557, (Modified Proctor).

B. In place density tests in accordance with ASTM D 6938.

C. Testing laboratory shall operate in accordance with ASTM D 3740 and E 329 and be acceptable to the Engineer.

D. Testing laboratory and Project Engineer/Project Representative shall be given a minimum of 48 hours notice prior to taking any tests.

E. Owner shall select and engage the testing laboratory. Testing laboratory shall be responsible to the Owner and Owner's Engineer. Payment for laboratory and all tests shall be by Owner, except Owner specifically reserves the right to deduct from Contractor's payment, expense, and charges of testing laboratory when:

1. Contractor gives notice work is ready for inspection and testing, and fails to be ready for the test, and/or

2. Testing of the Contractor's work, products, or materials fail, and retesting is required, and/or

3. Contractor abuses services or interferes with the work of testing laboratory in conduct of this work.

F. Test results shall be furnished to the Engineer prior to continuing with associated or subsequent work.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Aggregate shall consist of processed and blended crushed stone. Aggregates shall be free from lumps and balls of clay, organic matter, objectionable coatings, and other foreign material and shall be durable and sound. Coarse aggregate shall have a percentage of wear not to exceed 65% after 500 revolutions as determined by ASTM C 131. Coarse aggregate shall meet applicable requirements of Section 800, Coarse Aggregate of the Georgia Department of Transportation Standard Specifications Construction of Transportation Systems, 2001 Edition. Material shall meet the following gradation requirements of Section 815.

Sieve Size	Percent by Weight Passing
2”	100
1–1/2”	97 – 100
3/4”	60 – 90
#10	25 – 45
#60	5 – 30
#200	4 – 11

B. Prime Coat: Shall consist of low viscosity liquid asphalt such as MC–30, MC–70, MC–250, RC–30, RC–70, or RC–250, conforming to Section 412 of the Georgia Department of Transportation Standard Specifications Construction of Transportation Systems, 2001 Edition.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify subbase has been tested, is dry, and slopes and elevations are correct.

B. ON SITE OBSERVATIONS OF WORK: Owner's Representative or Engineer will have the right to require any portion of the work be completed in their presence. If the work is covered up after such instruction, it shall be exposed by Contractor for observation at no additional cost to the Owner. However, if Contractor notifies Owner such work is scheduled, and the Owner fails to appear within 48 hours, Contractor may proceed. All work completed and materials furnished shall be subject to review by the Owner, Engineer, or Project Representative. Improper work shall be reconstructed. All materials, which do not conform to requirements of specifications, shall be removed from the work upon notice being received from Engineer for rejection of such materials. Engineer shall have the right to mark rejected materials to distinguish them as such.

Contractor shall give the Owner, Project Engineer or Project Representative a minimum of 48 hours notice for all required observations or tests.

3.2 PREPARATION

A. Subbase shall be graded and shaped conforming to the lines, grades, and cross sections required and cleaned of all foreign substances prior to constructing base course. Do not place base on soft, muddy or frozen surfaces. Correct irregularities in subbase slope and elevation by scarifying, reshaping, and recompacting.

B. At the time of base course construction, subbase shall contain no frozen material.

C. Surface of subbase shall be checked by the Engineer or Project Representative for adequate compaction and surface tolerances. Ruts or soft yielding spots appearing in areas of subbase course having inadequate compaction, and areas not smooth or which vary in elevation more than 3/8 inch above or below required grade established on the plans, shall be corrected to the satisfaction of the Engineer or Project Representative. Base material shall not be placed until subbase has been properly prepared and test results have so indicated.

3.3 AGGREGATE PLACEMENT

A. Aggregate shall be placed with an acceptable spreader in accordance with Georgia Department of Transportation Standard Specifications Construction of Transportation Systems, 2001 Edition Section 310 and in accordance with all terms included in these specifications. (Spreader shall contain a hopper, adjustable screed and designed so there will be a uniform, steady flow of material from the hopper. Spreader shall be capable of laying material without segregation across full width of the lane to a uniform thickness and to a uniform loose density.) Spreaders are not required on curb and gutter road sections.

B. Level and contour surfaces to elevations and slopes indicated.

C. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.

D. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.

E. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

F. While at optimum moisture (± 1–1/2%), compact base course with rollers capable of obtaining required density. Vibratory, flatwheel, and other rollers accepted by the Engineer may be used to obtain required compaction. Rolling shall continue until base is compacted to 98% of the maximum laboratory dry density as determined by ASTM D 1557. In–place density of the compacted base will be determined in accordance with ASTM D 6938.

3.4 PRIME COAT

A. Bituminous material for the prime coat shall be applied uniformly and accurately in quantities of not less than 0.15 gallons per square yard nor more than 0.30 gallons per square yard of base course. All irregularities in the base course surface shall be corrected prior to application of prime coat. Clean the base course of all mud, dirt, dust, and caked and loose material

B. Do not apply prime to a wet surface nor when temperature is below 40°F in the shade. Do not apply prime when rain threatens nor when weather conditions prevent proper construction and curing of prime coat.

C. The primed base should be adequately cured before the binder or surface course is laid. In general, a minimum of 48 hours should be allowed for complete curing. Ordinarily, proper surface condition of the prime is indicated by a slight change in the shiny black appearance to a slightly brown color.

3.5 TOLERANCES

A. Flatness: Maximum variation of 1/4 inch measured with an acceptable 10–foot straight edge.

B. Scheduled Compacted Thickness: Within 3/8 inch.

C. Variation from Design Elevation: Within 3/8 inch.

D. Depth measurements for compacted thickness shall be made by test holes through the base course. Where base course is deficient, correct such areas by scarifying, adding base material, and recompacting as directed by the Engineer.

3.6 FIELD QUALITY CONTROL

A. Density and moisture testing will be performed in accordance with ASTM D 1557 and ASTM D 6938.

B. If tests indicate Work does not meet specified requirements, remove Work, replace and retest.

C. Frequency of Tests:

1. Base Density and Thickness – One test per 5,000 square feet.

END OF SECTION 32 11 23

SECTION 32 12 16GA

ASPHALT PAVING

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SECTION 32 12 16GA

ASPHALT PAVING

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Surface Course

B. Binder Course

1.2 RELATED SECTIONS

A. Section 31 00 00 – Earthwork

B. Section 32 11 23 – Aggregate Base Course

1.3 OMITTED

1.4 REFERENCES (LATEST REVISION)

A. ASTM D 946 – Penetration–Graded Asphalt–Cement for Use in Pavement Construction.

B. ASTM E 329 – Agencies Engaged in Construction Inspection and/or Testing.

C. ASTM D 3740 – Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock Used in Engineering Design and Construction.

D. ASTM D 2726 – Bulk Specific Gravity and Density of Non–Absorptive Compacted Bituminous Mixtures.

E. ASTM D 2950 – Density of Bituminous Concrete in Place by Nuclear Methods.

F. ASTM D 1754 – Effect of Heat and Air on Asphalt Materials (Thin–film Oven Test).

G. ASTM D 1188 – Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with Georgia Department of Transportation Standard Specifications Construction of Transportation Systems, 2001 Edition.

B. Mixing Plant: Conform to Georgia Department of Transportation Standard Specifications Construction of Transportation Systems, 2001 Edition.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not place asphalt mixture when ambient air temperature is less than that indicated in the Table nor when the surface is wet or frozen.

Lift Thickness	Min. Air Temperature, Degrees F.
1” or Less	55
1.1” to 2”	45
2.1” to 3”	35
3.1” to 4”	30
4.1” to 8”	Contractor’s Discretion

B. Mixture shall be delivered to the spreader at a temperature between 250 degrees F and 325 degrees F.

1.7 GUARANTEE

A. Contractor shall guarantee the quality of materials and workmanship for a period of 12 months after acceptance. Defects discovered during this period shall be repaired by the Contractor at no cost to the Owner.

1.8 TESTING

A. Testing laboratory shall operate in accordance with ASTM D 3740 and E 329 and be acceptable to the Engineer.

B. Testing laboratory and Project Engineer/Project Representative shall be given a minimum of 48 hours notice prior to taking any tests.

C. Owner shall select and engage the testing laboratory. Testing laboratory shall be responsible to the Owner and Owner’s Engineer. Payment for laboratory and all tests shall be by Owner, except Owner specifically reserves the right to deduct from Contractor’s payment, expense, and charges of testing laboratory when:

1. Contractor gives notice work is ready for inspection and testing, and fails to be ready for the test, and/or

2. Testing of the Contractor’s work, products, or materials fail, and retesting is required, and/or

3. Contractor abuses services or interferes with the work of testing laboratory in conduct of this work.

D. Test results shall be furnished to the Engineer prior to continuing with associated or subsequent work.

PART 2 – PRODUCTS

2.1 TACK COAT

A. Material: Shall be PG67–22, asphalt cement, conforming to Sections 413 and 820 of the Georgia Department of Transportation Standard Specifications Construction of Transportation Systems, 2001 Edition. When the temperature in the shade exceeds 70 degrees F, an emulsion such as CRS – 2h or CRS – 3 may be used.

2.2 ASPHALT CEMENT AND ADDITIVES

A. Asphalt Cement: Shall conform to the requirements of Section 820 of the Georgia Department of Transportation Standard Specifications Construction of Transportation Systems, 2001 Edition. The material shall be PG67–22.

B. Anti–Stripping: Shall conform to requirements of Section 831 of the Georgia Department of Transportation Standard Specifications Construction of Transportation Systems, 2001 Edition.

2.3 AGGREGATES

A. General: Mineral aggregate shall be composed of fine aggregate or a combination of fine and coarse aggregate. Coarse aggregate shall be the portion of material retained on a No. 8 sieve.

B. Fine aggregate shall be considered the portion passing a No. 8 sieve. Fine aggregate, coarse aggregate, and any additives in combination with the specified percentage of asphalt cement shall meet the requirements of tests specified, before acceptance may be given for their individual use.

C. Fine Aggregate: Shall conform to the requirements of Section 802 of the Georgia Department of Transportation Standard Specifications Construction of Transportation Systems, 2001 Edition.

D. Coarse Aggregate: Shall be granite stone and conform to the requirements of Section 802.02 of the Georgia Department of Transportation Standard Specifications Construction of Transportation Systems, 2001 Edition.

E. Surface Course: Shall consist of fine and coarse aggregate and mineral filler uniformly mixed with hot asphalt cement in an acceptable mixing plant. Job mix formula and design limits shall conform to 9.5 mm Superpave Level B, 12.5 mm Superpave requirements.

F. Intermediate or Binder Course: Shall consist of fine and coarse aggregate and mineral filler uniform mixing with hot asphalt cement in an acceptable mixing plant. Job mix formula and design limits shall conform to 19 mm Superpave requirements.

2.4 SOURCE QUALITY CONTROL AND TESTS

A. Section 01 45 00 – Quality Control and Section 01 45 23 – Testing and Inspecting Services.

B. Submit proposed mix design for review prior to beginning of work.

C. Test samples in accordance with the requirements of these specifications.

PART 3 – EXECUTION

3.1 EXAMINATION

A. On–Site Observations: Owner's Representative or Engineer will have the right to require any portion of work be completed in their presence. If work is covered up after such

instruction, it shall be exposed by the Contractor for observation at no additional cost to Owner. However, if Contractor notifies Engineer such work is scheduled, and Engineer fails to appear within 48 hours, the Contractor may proceed. All work completed and materials furnished shall be subject to review by the Engineer or Project Representative. Improper work shall be reconstructed. All materials, which do not conform to requirements of specifications, shall be removed from the work upon notice being received from Engineer for rejection of such materials. Engineer shall have the right to mark rejected materials to distinguish them as such.

Contractor shall give the Owner, Project Engineer or Project Representative a minimum of 48 hours notice for all required observations or tests.

B. Contractor shall verify base has been tested, is dry, and gradients and elevations are correct.

3.2 PREPARATION

A. Apply tack coat in accordance with Section 413 of the Georgia Department of Transportation Standard Specifications Construction of Transportation Systems, 2001 Edition. Rate of application shall be 0.04 to 0.06 gallons per square yard of surface.

B. Work shall be planned so no more tack coat than is necessary for the day's operation is placed on the surface. All traffic not essential to the work should be kept off the tack coat.

C. Apply tack coat to contact surfaces of curbs and gutters. Apply in manner so exposed curb or gutter surfaces are not stained.

D. Coat surfaces of manhole frames and inlet frames with oil to prevent bond with asphalt pavement. Do not tack coat these surfaces.

3.3 PLACEMENT

A. Construction shall be in accordance with Section 400 of the Georgia Department of Transportation Standard Specifications Construction of Transportation Systems, 2001 Edition

B. Asphaltic concrete shall not be placed on a wet or frozen surface.

C. Compaction shall commence as soon as possible after the mixture has been spread to the desired thickness. Compaction shall be continuous and uniform over the entire surface. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks. Compaction rolling shall be complete before material temperature drops below 185° F.

D. Areas of pavement with deficient thickness or density shall be removed and replaced at no additional cost to the Owner.

3.4 TOLERANCES

A. General: All paving shall be subject to visual and straightedge evaluation during construction operations and thereafter prior to final acceptance. A 10 foot straightedge shall be maintained in the vicinity of the paving operation at all times for the purpose of measuring surface irregularities on all paving courses. The straightedge and labor for its use shall be provided by the Contractor. The surface of all courses shall be checked with the straightedge as necessary to detect surface irregularities. Irregularities such as rippling, tearing or pulling, which in the judgment of the Engineer indicate a continuing problem in equipment, mixture or operating technique, will not be permitted to recur. The paving operation shall be stopped until appropriate steps are taken by the Contractor to correct the problem.

B. Flatness: All irregularities in excess of 1/8 inch in 10 feet for surface courses and 3/16 inch in 10 feet for intermediate and base courses shall be corrected.

1. General Paving: Less than 1/4 inch.

2. Accessible Routes: Shall not exceed 1/4 inch. However, accessible routes shall not exceed maximum ADA allowable slopes. Contractor shall remove and replace any and all portions of the accessible route that exceed maximum ADA allowable slopes.

3. Variation from Design Elevation: Less than 1/4 inch.

4. Scheduled Compacted Thickness: Less than 1/4 inch under tolerance.

5. Pavement Deficient in Thickness: When measurement of any core indicates the pavement is deficient in thickness, additional cores will be drilled 10 feet either side of the deficient core along the centerline of the lane until the cores indicate the thickness conforms to the above specified requirements. A core indicating thickness deficiencies is considered a failed test. Pavement deficient in thickness shall be removed and replaced with the appropriate thickness of materials. If the Contractor believes the cores and measurements taken are not sufficient to indicate fairly the actual thickness of the pavement, additional cores and measurements will be taken, provided the Contractor will bear the extra cost of drilling the cores and filling the holes in the roadway as directed.

3.5 FIELD QUALITY CONTROL

A. Acceptance of the in–place density of the surface course shall be in accordance with the Georgia Department of Transportation Standard Specifications Construction of Transportation Systems, 2001 Edition.

B. Density Testing: Performed in accordance with ASTM D–2726 and ASTM D–2950. Core samples for each day's operation shall be taken, tested and results reported to the Engineer the following day. The areas sampled shall be properly restored by the Contractor at no additional cost to the Owner. Nuclear gauge tests shall be taken during the asphaltic concrete placement.

1. The pavement core and nuclear gauge densities shall range between 94% and 96% of the theoretical maximum laboratory density.

C. Temperature:

1. Asphaltic concrete shall not exceed 325 degrees F at any time.

2. Asphaltic concrete shall not be placed once the temperature of the mix falls below 250 degrees F or the delivered temperature is more than 15 degrees F below the batch plant's delivery ticket.

3. Temperature at time of loading shall be recorded on the truck delivery ticket.

D. Frequency of Tests:

1. Asphaltic Concrete – One test for each 250 tons placed.

   a. Asphalt extraction and gradation test.

   b. Core Sample

2. Field determination of density by nuclear method every 5,000 square feet during construction of the asphaltic concrete binder/surface course.

END OF SECTION 32 12 16GA

SECTION 32 12 16.36 – ATHLETIC TRACK ASPHALT PAVING

PART 1 – GENERAL

1.1 SUMMARY

A. This section includes provisions for hot-mixed asphalt concrete paving over prepared subbase.

B. This section includes provisions for replacing pavement removed during the course of the Work or damaged resulting from Contractor's operations.

1.2 REFERENCES

A. Applicable State or Provincial Department of Transportation Standard Specifications.

B. "Standard Specifications for Highway Materials and Methods of Sampling and Testing, American Association of State Highway and Transportation Officials (AASHTO)."

C. "American Society for Testing and Materials (ASTM)."

1.3 SUBMITTALS

A. Material Certificates signed by material producer and Contractor, certifying that each material item complies with or exceeds specified requirements.

B. Field Test Reports: Submit results of field testing directly to the Engineer.

C. Track & Field Paving Experience:

1. Track Paving Contractor Qualifications:
   a. Track Paving Contractor shall provide a list of completed facilities, minimum of 5 running tracks, in the past 5 years.
2. On-site Project Manager/Superintendent Qualifications:
   a. Provide a list of completed facilities, minimum of 5 running tracks, in the past 5 years.
   b. The Project Manager/Superintendent will be on-site during all track & field paving operations. Substitution of project manager/superintendent shall not be permitted.
3. The experience qualifications in items 1 & 2 above for the Track Paving Contractor and the on-site Project Manager/Superintendent may be fulfilled by the Track & Field Synthetic Surfacing Contractor if the on-site Project Manager/Superintendent for the Track & Field Synthetic Surfacing Contractor will be on-site to supervise all track & field paving operations.

D. Asphalt truck delivery tickets: Contractor to collect and submit all delivery tickets.

1.4 SITE CONDITIONS

A. Weather Limitations: Apply tack coats when ambient temperature is above 50 DegF (10 DegC) and when temperature has not been below 35 DegF (1 DegC) for 12 hours immediately prior to application. Do not apply when base is wet or contains an excess of moisture.

B. Construct hot-mixed asphalt concrete surface course when atmospheric temperature is above 40 DegF (4 DegC) and when base is dry. Base course may be placed when air temperature is above 30 DegF (minus 1 DegC) and rising.

C. Grade Control: Establish and maintain required lines and elevations.

D. In no instance shall the materials and thicknesses of pavement and subbase courses replaced be less than that removed, unless approved by the Engineer.

1.5 SEQUENCING AND SCHEDULING

A. Coordinate the placement of asphalt concrete pavement with the completion of underground work by other trades.

B. The asphalt top course shall be allowed to cure for 28 days prior to application of resilient track surfacing.

PART 2 – PRODUCTS

2.1 MATERIALS

A. General: All hot mix asphalt shall be in accordance with applicable provisions of State or Provincial Department of Transportation “Standard Specifications for Road and Bridge Construction”, except as herein modified.

1. No RAP (Reclaimed Asphalt Pavement) content will be allowed in the asphalt wearing course.
2. The RAP (Reclaimed Asphalt Pavement) content in the asphalt binder course shall be 15 percent or less.
3. The asphaltic cement (AC-1) content shall be 4.0 to 6.0 percent by weight of the total composite mixture.
4. Coarse aggregate (material retained on the 4.75mm sieve) shall be sound, angular crushed stone or gravel (shale is not recommended).
5. Fine aggregate (material passing the 4.75mm sieve and retained on the #200 (0.075mm) sieve) shall be sand, stone sand and stone screenings Class B quality or better and gradation FA-3.
6. Mineral filler (material passing the #200 sieve) shall be dry limestone or dust.

B. Asphalt Binder Course:
1. The gradation of the composite aggregate shall conform to the following:

SIEVE	TOTAL % PASSING
3/4”	100
1/2”	90-100
3/8”	80
#4	45-70
#8	25-55
#30	(19)
#50	5-20 (12)
#100	5-16 (6.5)
#200	2-9 (3)

C. Asphalt Top Course:

1. The gradation of the composite aggregate shall conform to the following:

SIEVE	TOTAL % PASSING
1/2”	100
3/8”	90-100
#4	60-90 (70)
#8	35-65 (49)
#30	(22)
#50	6-25 (14)
#100	(8)
#200	2-10 (3)
Note: The aggregate grain size should be as close to the figures in parentheses for the maximum density of the asphalt mixture.	

D. Asphalt Tack Coat:

1. The primer for application on asphalt surfaces (tack coat) shall be RC-1.

PART 3 – EXECUTION

3.1 SURFACE PREPARATION

A. General: Remove loose material from compacted subbase surface immediately before commencing paving operations.

B. Proof-roll prepared subbase surface with a ten-ton static, steel-wheel roller to check for unstable areas and areas requiring additional compaction, witnessed by the Engineer at least 48 hours prior to scheduled paving operations.

C. Do not begin paving work until deficient subbase areas have been corrected and are ready to receive paving.

D. Sawcut edges of existing pavement to achieve straight line transitions between old and new pavement. Make a second sawcut through the top course of existing pavement 18 inches from the first cut to provide a staggered joint.

E. Tack Coat: Apply to contact surfaces of previously constructed asphalt or Portland cement concrete and surfaces abutting or projecting into asphalt concrete pavement. Distribute at rate of 0.03 to 0.07 gallons per square yard of surface.

F. Allow to dry until at proper condition to receive paving.

G. Exercise care in applying bituminous materials to avoid smearing of adjoining surfaces. Remove and clean damaged surfaces.

H. Do not commence pavement replacement operations until all buried work beneath pavement repair has been completed to the satisfaction of the Engineer.

I. Where trench dimensions preclude the use of proof rolling equipment, demonstrate the stability of the subgrade and subbase through other means, as acceptable to the Engineer.

3.2 PLACING AND COMPACTING MIX

A. General: Place and compact asphalt pavement courses in accordance with applicable state or provincial department of transportation specifications unless otherwise specified.

B. Place inaccessible and small areas by hand and compact with hot hand tampers or vibrating plate compactors.

C. Chamfer edges of walks at 45-degree angle where walks do not abut curb.

D. Joints: Make joints between old and new pavements, or between successive days' work, to ensure continuous bond between adjoining work. Construct joints to have same texture, density, and smoothness as other sections of asphalt concrete course. Clean contact surfaces and apply tack coat.

E. Place tack coat between successive courses if more than 48 hours have elapsed after placing the preceding course. Apply tack coat at a rate of 0.03 to 0.07 gallons per square yard of surface.

F. Compaction: Compact asphalt pavement courses with a static steel wheel roller only, unless otherwise approved by the Engineer, based upon work conditions. The average sub-lot (daily or 400 tons, whichever is less) in-place density measurement for asphalt surface course mixture shall be 94% of the theoretical maximum density at optimum with no single value less than 92%. Acceptable average measurements shall be made by use of a correlated nuclear density gauge, a correlated Pavement Quality indicator or Pave Tracker or by cutting four cores per lift, per day, and testing per AASHTO T-166, Method C. Additional testing shall be performed on any given day once 400 tons of asphalt is placed on that day.

G. Remove and patch areas of any asphalt concrete course deemed unsatisfactory by the Engineer at the Contractor's expense. Remove hardened or set asphalt by saw cutting.

H. Adhere to applicable state or provincial department of transportation specifications for compaction requirements unless otherwise noted herein. This, however, shall not relieve the Contractor of his responsibility to provide a well densified pavement. It shall be the Contractor's obligation to recognize difficulties in compacting the mix, and to make appropriate corrections.

I. Roll and compact the asphalt concrete course until the finished surface is free from depressions, waves or other defects that would prevent proper drainage. The finished surface shall be uniform in texture and appearance.

J. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

K. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.3 FIELD QUALITY CONTROL

A. General: Testing in-place asphalt concrete courses for compliance with requirements for thickness, and surface smoothness and compaction will be done by Owner's testing laboratory. Repair or remove and replace unacceptable paving as directed by Engineer.

B. Thickness: In-place compacted thickness tested in accordance with ASTM D3549 will not be acceptable if exceeding following allowable variations:

1. Binder and Surface Course: Plus or minus 1/4 inch.
2. Cumulative Thickness Tolerances: Plus or minus 1/4 inch for nominal cumulative thicknesses less than or equal to 4 inches. Plus or minus 1/2 inch for nominal cumulative thicknesses greater than 4 inches.

C. Surface Smoothness: Test finished surface of each asphalt concrete course for smoothness, using 10-foot straightedge applied parallel with and at right angles to centerline of paved area. Surfaces will not be acceptable if exceeding the following tolerances for smoothness:

1. Binder Course Surfaces: 1/4 inch.
2. Wearing Course Surface: 3/16 inch.
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

D. Compaction:

1. In place density tests shall be performed on the asphalt top/wearing course every 2,000 feet.
2. In place density limits shall be between the Lower Specification Limit (92%) and the Upper Specification Limit (96%) for an average of 94% of Theoretical Maximum Density.

E. The Engineer will review all collected and submitted asphalt truck deliver tickets for both binder and wearing courses to ensure that reclaimed asphalt pavement (RAP) content is as approved.

F. Check surface areas at intervals as directed by Engineer.

G. Scuff Resistance: If, in the opinion of the Engineer, the pavement does not demonstrate reasonable resistance to deformation by punching loads and scuffing under horizontally applied shearing loads, after the pavement has cooled and hardened, the Engineer may require laboratory testing of cored pavement samples to determine the properties of the pavement; including aggregate gradation, asphalt content, air void ratio, density and any others deemed appropriate. If laboratory testing indicates that any parameters substantially deviate from the design mix tolerances specified by applicable state or provincial department of transportation, replace the affected areas of pavement at no additional cost, and reimburse the Owner for all costs incurred in procurement and testing of cores.

3.4 TRACK & FIELD REQUIREMENTS

A. Flood Testing:

1. The completed asphalt surface that will receive track & field synthetic surfacing must be flood tested in the presence of the track & field synthetic surfacing contractor to determine if any depressions require remediation prior to the installation of the track & field synthetic surfacing.

B. Track & Field Slope Requirements (NFSHSA (High School)):

1. Track Oval: Direction of running, maximum slope 1:1000 (0.1%); Cross/lateral slope (perpendicular to lane lines), outermost lane down to Lane 1, 2:100 (2.0%) maximum.
2. High Jump: Maximum slope of the approach and take-off area shall not exceed 1:100 (1.0%) downward toward the center of the crossbar.
3. Long/Triple Jump, Javelin, and Pole Vault Runways:
   a. Direction of running/jumping, maximum slope 1:1000 (0.1%).
   b. Cross / lateral slope (perpendicular to runway lines), 2:100 (2.0%) maximum.

END OF SECTION 32 12 16.36

SECTION 32 12 16GA

ASPHALT PAVING

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1.2	Related Sections	32 12 16GA–1
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1.7	Guarantee	32 12 16GA–2
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SECTION 32 12 16GA

ASPHALT PAVING

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Surface Course

B. Binder Course

1.2 RELATED SECTIONS

A. Section 31 00 00 – Earthwork

B. Section 32 11 23 – Aggregate Base Course

1.3 OMITTED

1.4 REFERENCES (LATEST REVISION)

A. ASTM D 946 – Penetration–Graded Asphalt–Cement for Use in Pavement Construction.

B. ASTM E 329 – Agencies Engaged in Construction Inspection and/or Testing.

C. ASTM D 3740 – Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock Used in Engineering Design and Construction.

D. ASTM D 2726 – Bulk Specific Gravity and Density of Non–Absorptive Compacted Bituminous Mixtures.

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G. ASTM D 1188 – Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with Georgia Department of Transportation Standard Specifications Construction of Transportation Systems, 2001 Edition.

B. Mixing Plant: Conform to Georgia Department of Transportation Standard Specifications Construction of Transportation Systems, 2001 Edition.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not place asphalt mixture when ambient air temperature is less than that indicated in the Table nor when the surface is wet or frozen.

Lift Thickness	Min. Air Temperature, Degrees F.
1” or Less	55
1.1” to 2”	45
2.1” to 3”	35
3.1” to 4”	30
4.1” to 8”	Contractor’s Discretion

B. Mixture shall be delivered to the spreader at a temperature between 250 degrees F and 325 degrees F.

1.7 GUARANTEE

A. Contractor shall guarantee the quality of materials and workmanship for a period of 12 months after acceptance. Defects discovered during this period shall be repaired by the Contractor at no cost to the Owner.

1.8 TESTING

A. Testing laboratory shall operate in accordance with ASTM D 3740 and E 329 and be acceptable to the Engineer.

B. Testing laboratory and Project Engineer/Project Representative shall be given a minimum of 48 hours notice prior to taking any tests.

C. Owner shall select and engage the testing laboratory. Testing laboratory shall be responsible to the Owner and Owner’s Engineer. Payment for laboratory and all tests shall be by Owner, except Owner specifically reserves the right to deduct from Contractor’s payment, expense, and charges of testing laboratory when:

1. Contractor gives notice work is ready for inspection and testing, and fails to be ready for the test, and/or

2. Testing of the Contractor’s work, products, or materials fail, and retesting is required, and/or

3. Contractor abuses services or interferes with the work of testing laboratory in conduct of this work.

D. Test results shall be furnished to the Engineer prior to continuing with associated or subsequent work.

PART 2 – PRODUCTS

2.1 TACK COAT

A. Material: Shall be PG67–22, asphalt cement, conforming to Sections 413 and 820 of the Georgia Department of Transportation Standard Specifications Construction of Transportation Systems, 2001 Edition. When the temperature in the shade exceeds 70 degrees F, an emulsion such as CRS – 2h or CRS – 3 may be used.

2.2 ASPHALT CEMENT AND ADDITIVES

A. Asphalt Cement: Shall conform to the requirements of Section 820 of the Georgia Department of Transportation Standard Specifications Construction of Transportation Systems, 2001 Edition. The material shall be PG67–22.

B. Anti–Stripping: Shall conform to requirements of Section 831 of the Georgia Department of Transportation Standard Specifications Construction of Transportation Systems, 2001 Edition.

2.3 AGGREGATES

A. General: Mineral aggregate shall be composed of fine aggregate or a combination of fine and coarse aggregate. Coarse aggregate shall be the portion of material retained on a No. 8 sieve.

B. Fine aggregate shall be considered the portion passing a No. 8 sieve. Fine aggregate, coarse aggregate, and any additives in combination with the specified percentage of asphalt cement shall meet the requirements of tests specified, before acceptance may be given for their individual use.

C. Fine Aggregate: Shall conform to the requirements of Section 802 of the Georgia Department of Transportation Standard Specifications Construction of Transportation Systems, 2001 Edition.

D. Coarse Aggregate: Shall be granite stone and conform to the requirements of Section 802.02 of the Georgia Department of Transportation Standard Specifications Construction of Transportation Systems, 2001 Edition.

E. Surface Course: Shall consist of fine and coarse aggregate and mineral filler uniformly mixed with hot asphalt cement in an acceptable mixing plant. Job mix formula and design limits shall conform to 9.5 mm Superpave Level B, 12.5 mm Superpave requirements.

F. Intermediate or Binder Course: Shall consist of fine and coarse aggregate and mineral filler uniform mixing with hot asphalt cement in an acceptable mixing plant. Job mix formula and design limits shall conform to 19 mm Superpave requirements.

2.4 SOURCE QUALITY CONTROL AND TESTS

A. Section 01 45 00 – Quality Control and Section 01 45 23 – Testing and Inspecting Services.

B. Submit proposed mix design for review prior to beginning of work.

C. Test samples in accordance with the requirements of these specifications.

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3.1 EXAMINATION

A. On–Site Observations: Owner's Representative or Engineer will have the right to require any portion of work be completed in their presence. If work is covered up after such

instruction, it shall be exposed by the Contractor for observation at no additional cost to Owner. However, if Contractor notifies Engineer such work is scheduled, and Engineer fails to appear within 48 hours, the Contractor may proceed. All work completed and materials furnished shall be subject to review by the Engineer or Project Representative. Improper work shall be reconstructed. All materials, which do not conform to requirements of specifications, shall be removed from the work upon notice being received from Engineer for rejection of such materials. Engineer shall have the right to mark rejected materials to distinguish them as such.

Contractor shall give the Owner, Project Engineer or Project Representative a minimum of 48 hours notice for all required observations or tests.

B. Contractor shall verify base has been tested, is dry, and gradients and elevations are correct.

3.2 PREPARATION

A. Apply tack coat in accordance with Section 413 of the Georgia Department of Transportation Standard Specifications Construction of Transportation Systems, 2001 Edition. Rate of application shall be 0.04 to 0.06 gallons per square yard of surface.

B. Work shall be planned so no more tack coat than is necessary for the day's operation is placed on the surface. All traffic not essential to the work should be kept off the tack coat.

C. Apply tack coat to contact surfaces of curbs and gutters. Apply in manner so exposed curb or gutter surfaces are not stained.

D. Coat surfaces of manhole frames and inlet frames with oil to prevent bond with asphalt pavement. Do not tack coat these surfaces.

3.3 PLACEMENT

A. Construction shall be in accordance with Section 400 of the Georgia Department of Transportation Standard Specifications Construction of Transportation Systems, 2001 Edition

B. Asphaltic concrete shall not be placed on a wet or frozen surface.

C. Compaction shall commence as soon as possible after the mixture has been spread to the desired thickness. Compaction shall be continuous and uniform over the entire surface. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks. Compaction rolling shall be complete before material temperature drops below 185° F.

D. Areas of pavement with deficient thickness or density shall be removed and replaced at no additional cost to the Owner.

3.4 TOLERANCES

A. General: All paving shall be subject to visual and straightedge evaluation during construction operations and thereafter prior to final acceptance. A 10 foot straightedge shall be maintained in the vicinity of the paving operation at all times for the purpose of measuring surface irregularities on all paving courses. The straightedge and labor for its use shall be provided by the Contractor. The surface of all courses shall be checked with the straightedge as necessary to detect surface irregularities. Irregularities such as rippling, tearing or pulling, which in the judgment of the Engineer indicate a continuing problem in equipment, mixture or operating technique, will not be permitted to recur. The paving operation shall be stopped until appropriate steps are taken by the Contractor to correct the problem.

B. Flatness: All irregularities in excess of 1/8 inch in 10 feet for surface courses and 3/16 inch in 10 feet for intermediate and base courses shall be corrected.

1. General Paving: Less than 1/4 inch.

2. Accessible Routes: Shall not exceed 1/4 inch. However, accessible routes shall not exceed maximum ADA allowable slopes. Contractor shall remove and replace any and all portions of the accessible route that exceed maximum ADA allowable slopes.

3. Variation from Design Elevation: Less than 1/4 inch.

4. Scheduled Compacted Thickness: Less than 1/4 inch under tolerance.

5. Pavement Deficient in Thickness: When measurement of any core indicates the pavement is deficient in thickness, additional cores will be drilled 10 feet either side of the deficient core along the centerline of the lane until the cores indicate the thickness conforms to the above specified requirements. A core indicating thickness deficiencies is considered a failed test. Pavement deficient in thickness shall be removed and replaced with the appropriate thickness of materials. If the Contractor believes the cores and measurements taken are not sufficient to indicate fairly the actual thickness of the pavement, additional cores and measurements will be taken, provided the Contractor will bear the extra cost of drilling the cores and filling the holes in the roadway as directed.

3.5 FIELD QUALITY CONTROL

A. Acceptance of the in–place density of the surface course shall be in accordance with the Georgia Department of Transportation Standard Specifications Construction of Transportation Systems, 2001 Edition.

B. Density Testing: Performed in accordance with ASTM D–2726 and ASTM D–2950. Core samples for each day's operation shall be taken, tested and results reported to the Engineer the following day. The areas sampled shall be properly restored by the Contractor at no additional cost to the Owner. Nuclear gauge tests shall be taken during the asphaltic concrete placement.

1. The pavement core and nuclear gauge densities shall range between 94% and 96% of the theoretical maximum laboratory density.

C. Temperature:

1. Asphaltic concrete shall not exceed 325 degrees F at any time.

2. Asphaltic concrete shall not be placed once the temperature of the mix falls below 250 degrees F or the delivered temperature is more than 15 degrees F below the batch plant's delivery ticket.

3. Temperature at time of loading shall be recorded on the truck delivery ticket.

D. Frequency of Tests:

1. Asphaltic Concrete – One test for each 250 tons placed.

   a. Asphalt extraction and gradation test.

   b. Core Sample

2. Field determination of density by nuclear method every 5,000 square feet during construction of the asphaltic concrete binder/surface course.

END OF SECTION 32 12 16GA

SECTION 32 17 23

PAVEMENT MARKINGS

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SECTION 32 17 23

PAVEMENT MARKINGS

PART 1 – GENERAL

1.1 WORK INCLUDED

A. Striping shall consist of furnishing and applying traffic line paint in accordance with the contract drawings and specifications, and the requirements of the Georgia Department of Transportation Standard Specifications Construction of Transportation Systems, 2001 Edition.

1.2 QUALITY ASSURANCE

A. Material and equipment shall be standard product of a manufacturer who has manufactured them for a minimum of 2 years and who provides published data on quality and performance of the product.

1.3 GUARANTEE

A. Contractor shall guarantee the quality of materials and workmanship for a period of 12 months after acceptance. Defects discovered during this period shall be repaired by Contractor at no cost to the Owner.

PART 2 – PRODUCTS

2.1 PAINT

A. Paint shall be in conformance with Section 870 of the Georgia Department of Transportation Standard Specifications Construction of Transportation Systems, 2001 Edition.

2.2 EQUIPMENT

A. The traveling traffic stripe painter shall be adaptable to traveling at a uniform, predetermined rate of speed both uphill and downhill in order to produce a uniform application of paint. Paint machine shall be of the spray type, capable of satisfactorily applying paint under pressure with a uniformity of feed through nozzles spraying directly upon pavement. Each machine shall be capable of applying three separate stripes, either solid or skip, in any specified pattern by utilizing three adjacent spray nozzles at the same time. Each paint tank shall be equipped with a mechanical agitator. Each nozzle shall be equipped with satisfactory cutoff valves which will apply broken or skip lines automatically. Each nozzle shall have a mechanical bead dispenser operating simultaneously with spray nozzle and distribute beads in a uniform pattern at the rate specified. Each nozzle shall also be equipped with suitable line guides consisting of metallic shrouds or air blasts.

Hand painting equipment shall consist of suitable brushes, templates and guides necessary to produce satisfactory results.

Cleaning equipment shall consist of necessary brushes, brooms, scrapers, grinders, high pressure water jets and air blasters required to satisfactorily remove all foreign matter, from surfaces to be painted, without damage to the underlying pavement.

The traveling traffic stripe painter shall also be equipped with paint meters which will indicate amount of paint dispensed from each tank. Small, portable applicators or other special equipment may also be required.

2.3 GLASS BEADS

A. Glass beads shall be in conformance with Section 652 of the Georgia Department of Transportation Standard Specifications Construction of Transportation Systems, 2001 Edition.

2.4 PRODUCT REVIEW

A. Contractor shall provide the Engineer with a complete description of all products before ordering. The Engineer will review all products before they are ordered.

PART 3 – EXECUTION

3.1 CONSTRUCTION OBSERVATION

A. Engineer or Project Representative will have the right to require any portion of the work be completed in their presence. If the work is covered up after such instruction, it shall be exposed by Contractor for observation. However, if Contractor notifies Engineer, or Project Representative such work is scheduled and they fail to appear within 48 hours, the Contractor may proceed. All work completed and materials furnished shall be subject to review by the Engineer. Improper work shall be reconstructed. All materials which do not conform to requirements of specifications shall be removed from the work upon notice being received from Engineer for rejection of such materials. Engineer shall have the right to mark rejected materials to distinguish them as such. Contractor shall give Engineer or Project Representative a minimum of 48 hours notice for all required observations or tests.

3.2 STRIPING

A. Cleaning of Surface – Surfaces to be painted shall be thoroughly cleaned of all dust, dirt, grease, oil and other foreign matter before application of the paint.

B. Alignment – Traffic stripes shall be of the length, width and placement specified. On sections where no previously applied markings are present, Contractor shall establish control points, satisfactory to Engineer, spaced at intervals insuring accurate locations of the stripe.

C. Application – Traffic Stripe paint shall be applied by machine except for special areas and markings not adaptable to machine application, in which case, hand application will be permitted.

No paints shall be applied to areas of pavement when:

1. Any moisture or foreign matter is present on the surface;

2. The air temperature in the shade is below 50° F; or

3. Wind conditions are such as might cause dust to be deposited on prepared areas or to prevent satisfactory application of the paint and beads.

Painting shall be completed only during daylight hours and all painted areas shall be dry enough, before sunset, to permit crossing by traffic. All protective devices shall be removed not later than sunset to allow free movement of traffic at night.

Traffic stripe paint shall be thoroughly mixed in the shipping container before placing in machine tank. The paint machine tanks, connections and spray nozzles shall be thoroughly cleaned with thinner before starting each day's work.

The minimum wet film thickness for all painted areas shall be 15 mils.

Place a layer of glass beads immediately after laying the paint. Apply beads at a minimum rate of 6 pounds per gallon of paint.

D. Protective Measures – When painting is completed around traffic, Contractor shall furnish and place all warning and directional signs necessary to direct, control, and protect traffic during the striping operations. Warning signs shall be set up before the beginning of each operation and extra signs shall be kept well ahead of painting equipment. When necessary, a pilot car shall be used to protect both traffic and the painting operation. The freshly painted stripe shall be protected by cones or other satisfactory devices. All stripe damaged by traffic, or pavement marked by traffic crossing wet paint, shall be repaired or corrected as specified below.

E. Tolerance and Appearance – No stripe shall be less than the specified width. No stripe shall exceed the specified width by more than 1/2 inch. Alignment of the stripe shall not deviate from intended alignment by more than one inch on tangents and on curves up to and including one degree. On curves exceeding one degree, alignment of the stripe shall not deviate from the intended alignment by more than 2 inches.

Continued deviation from stated dimensions will be cause for stopping the Work and removing nonconforming stripe.

All stripes and segments of stripes shall present a clean cut, uniform and workmanlike appearance. All markings which fail to have a uniform, satisfactory appearance, either day or night, shall be corrected at the Contractor’s expense.

F. Corrective Measures – All traffic stripe which fails to meet the Specifications, permissible tolerances and appearance requirements, or is marred or damaged by traffic or from other causes, shall be corrected at Contractor's expense. All misted areas, drip and spattered paint shall be removed to the satisfaction of Engineer. In all instances, when it is necessary to remove paint, it shall take place by means satisfactory to Engineer, which will not damage the underlying surface of pavement. When necessary to correct a deviation, which exceeds permissible tolerance in alignment, the portion of stripe so affected shall be removed plus an additional 25 feet in each direction, and a new stripe then painted in accordance with these specifications.

G. Acceptance – All sections of painted stripe, words and symbols which have dried to the extent paint will not be picked up or marred by tires of vehicles, and which have been placed in reasonably close conformity with Plans and Specifications, will be accepted, and Contractor will be relieved of responsibility of maintenance on such sections.

END OF SECTION 32 17 23

SECTION 32 18 13 – SYNTHETIC TURF PLAYING FIELD SYSTEM

PART 1 – GENERAL

1.1 WORK INCLUDED

A. Provide all labor, equipment, and materials, and do work necessary to construct a synthetic turf field replacement, as indicated on the Drawings and as specified. Work shall include but shall not be limited to:

1. Synthetic surface including all inlays and/or painted lines/markings and related finish work.
2. Installation/replacement of perimeter anchor systems and subsurface drainage system including stone base and topping stone.

1.2 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirement shall govern.

1. American Association of State Highway and Transportation Officials (AASHTO):
   a. T 89 - Determining the Liquid Limit of Soils.
   b. T 90 - Determining the Plastic Limit and Plasticity Index of Soils.
2. Occupational Safety and Health Administration (OSHA).
3. Department of Transportation Standard Specifications
4. American Society for Testing and Materials (ASTM):
   a. D 395 - Rubber Property – Compression Test.
   b. D 418 - Pile Yarn Floor Covering Construction.
   c. D 2256 - Breaking Load (Strength) and Elongation of Yarn by the Single-Strand Method.
   d. D 3776 - Mass Per Unit Area (Weight) of Woven Fabric.
   e. D 3786 - Hydraulic Bursting Strength of Knitted Goods and Non-Woven Fabrics: Diaphragm Bursting Strength Tester Method.
   f. D 4491 - Water Permeability of Geotextiles by Permitivity.
   g. D 4533 - Trapezoid Tearing Strength of Geotextiles.
   h. D 4632 - Breaking Load and Elongation of Geotextiles (Grab Method).
   i. D 4833 - Index Puncture Resistance of Geotextiles, Geo-membranes, & Related Products.
   j. F 355 - Shock Absorbing Properties of Playing Surface Systems and Materials.
   k. F 405 - Corrugated Polyethylene (PE) Tubing and Fittings.
   l. F 449 - Subsurface Installation for Agricultural Drainage or Water Table Control.
   m. F 667 - 8, 10, 12 and 15-inch Corrugated Polyethylene Tubing and Fittings.

1.3 DEFINITIONS

A. Subgrade: The undisturbed earth or the compacted soil layer immediately below proposed drainage fill or playing field materials.

1.4 SUBMITTALS

A. Manufacturer's Product Data: Submit manufacturer's specifications and installation instructions for all products in the playing field system, including certifications and other data as may be required to show compliance with the Contract Documents. Included but not limited to the following; drainage pipe material, geotextile fabric perimeter turf anchoring system, goal post system and foundation sleeve and stone base.

B. Material Certifications: Manufacturer's or vendor's certified analysis for rubber and sand infill amendments.

C. Material samples. Submit three samples each of the following:

1. Gravel Materials – See Section 1.8, "Quality Control".

D. Synthetic Turf Material Samples and Test Reports:

1. Synthetic Turf – Three samples, approximately 7" x 11".
2. Rubber/Sand Mix with proper ratio or Rubber - three samples, approximately 8-ounces each.
3. Submit to Owner for approval - quality assurance information as delineated in paragraphs 1.5 Quality Assurance below.
4. Certified list of successful existing installations, including Owner representative and telephone number, attesting compliance with quality assurance information.
5. Certified copies of independent (third-party) laboratory reports on ASTM tests as follows:
    a. Pile Height, Face Weight & Total Fabric Weight - ASTM D418.
    b. Primary & Secondary Backing Weights – ASTM D418.
    c. Tuft Bind – ASTM D1335.
    d. Grab Tear Strength – ASTM D1682.
    e. Dynamic Cushion Test (G-max) - ASTM F-355, Procedure A (system).
6. Seam – Sewn or glued per manufacturers' recommendation.
    a. 24 inches in length.
7. Color: Submit sample of line markings for approval by Owner.

E. Supplier List: Submit list of procured and contracted suppliers of all materials required for the Playing Field System.

F. Shop Drawings:

1. Sample Warranty.
2. Seam layout of the field.

3. Striping plan: Submit one for each field.
4. Layout for Owner designated sports, showing any field lines, markings, boundaries and logos.
5. Construction detail sketches, especially those that may deviate from the plans and specifications. Include but not limited to the following; perimeter turf anchor details, details at irrigation valves, valve boxes, other inserts or fixed features, etc.

G. Manufacturer's Review: Submit written statement, signed by Contractor and synthetic field surfacing installer stating that the Drawings and Specifications have been reviewed by qualified representatives of the materials manufacturer, and that they are in agreement that the materials and system to be used for synthetic field surfacing are proper and adequate for the applications shown.

H. Statement of Supervision: Upon completion of the Work, Contractor to submit a written statement signed by the synthetic turf manufacturer stating that the field supervision by the manufacturer's representative was sufficient to insure proper application of the complete system and materials, that the Work was installed in accordance with the Contract Documents, and that the installation is acceptable to the manufacturer.

1.5 QUALITY ASSURANCE

A. The sports field contractor shall have previously installed at least six (6) artificial turf infill fields larger than 50,000 square feet in the last (3) years.

1. The sports field contractor is responsible for the subgrade fine grading, installation of fabric, installation of field drainage system, installation of the perimeter nailing system and installation of the stone base.

B. The synthetic field turf installation shall be performed by a firm and crew having completed at least six (6) fields in the last three (3) years on projects of similar size and type to this project. The firm shall have the approval of the synthetic field surfacing materials manufacturer. The synthetic field installation superintendent shall provide a list of the five (5) projects for which he was responsible.

C. The Sports Field Contractor and the Synthetic Turf Manufacturer/Supplier must have been in business under the same ownership for at least three years and shall have been installing similar sports fields for that entire period.

D. Provide test results from certified laboratory certifying capability of aggregate base course (stone base) to meet permeability and stability requirements before construction.

E. Lay test strip and establish compaction and density rates for each course with nuclear gauge before beginning permanent work.

F. The turf manufacturer/supplier shall submit a list of all completed products, using the specified turf system. The list shall include references for at least five of the projects.

G. The synthetic field surfacing manufacturer shall provide evidence indicating that the specified materials have been successfully utilized on work of similar scope to that shown and specified for this Project.

1.6 QUALITY CONTROL

A. Prior to construction: Submit samples of each of the following materials to establish Baseline specification and ratios for the remainder of the testing process.

1. Gravel Drainage Material: Provide a one-gallon sample of each gravel drainage source and for each type of gravel material to be used for testing. This could include:
   a. Gravel trench drainage material.
   b. Base Stone.
   c. Topping Stone.

B. During Construction: Submit samples of each of the following during mass production of gravel materials for performance testing and prior to shipping. All costs associated with materials testing shall be paid for by the Contractor.

1. Earthwork Material Qualification and Testing:
   a. If found necessary, submit the following test data for each potential borrow source.
      1) Particle Size Analysis:
         a) Method: AASHTO D422.
         b) Number of Tests: Three (3) per potential source.
         c) Acceptance Criteria: Gradation within specified limits.
      2) Maximum Density Determination:
         a) Method: Modified Proctor Test - ASTM D 1557.
         b) Number of Tests: Three (3) per potential source.
   b. Re-establish gradation and maximum density of fill material if source is changed during construction.
2. Earthwork/Compaction Testing:
   a. All compaction testing shall be performed by as required in Section 312333 “Trenching and Backfilling”.
   b. Compaction testing shall be performed to ascertain the compacted density of the fill and backfill materials in accordance with the following methods:
      1) In-place relative density:
         a) Method: ASTM D-1556, Sand Cone Method.
         b) ASTM D-2922, Nuclear Method.
      2) Number of Tests:
         a) One (1) per 5,000 SF in each vertical lift.
   c. The Engineer may direct additional tests to establish gradation, maximum density, and in-place density as required by working conditions.
   d. Acceptance Criteria: The sole criterion for acceptability of in-place fill shall be in situ dry density. Minimum dry density for all fill or backfill shall be 95 percent of the maximum dry density as determined by the Modified Proctor Test (ASTM D-1557). If a test fails to qualify, the fill shall be further compacted and re-tested. Subsequent test failures shall be followed by removal, replacement of the material and retesting.
3. Gravel Drainage/ Stone Base/Topping Stone Material:

a. A minimum of one-gallon sample for every 500 cubic yards of each material used shall be tested by the Playing Field Testing Agent for general compliance with the established Baseline specifications.

C. Testing Agents:

1. The Owner shall contract with, and pay for, an independent testing agent to certify and make recommendations regarding compaction, concrete, geotechnical and other items required by the Work. The Playing Field Contractor shall notify the Owner regarding timing, scheduling and use of these agents.
2. Playing Field Testing Agent:
   a. The Owner shall hire an independent Testing Agent to perform testing of the field system material components, as well as to certify the capability of the stone base course to meet permeability and stability requirements before construction. This Agent shall be A2LA accredited and insured.
   b. Gravel Materials Test Reports: The Playing Field Testing Agent is to report/submit test results as they are known and simultaneously to the Playing Field Contractor, the Owner and its representatives.

1.7 DELIVERY, STORAGE AND HANDLING

A. All materials shall be delivered and stored within the Contractor's work limits or in an area approved by the Owner. Materials shall be inspected for damage immediately upon delivery.

B. All material shall be stored in strict accordance with the manufacturer's recommendations.

C. Special care shall be exercised during delivery and storage to avoid damage to the products.

D. Products that are damaged will be removed and replaced, unless the product can be repaired in an acceptable manner by the Contractor, at his expense.

E. Packaged Materials:

1. Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery, and while stored at site.

F. Drainage Gravel and Stone Base:

1. Deliver tested and approved lots in clean, washed and covered trucks to eliminate contamination during transportation. Place directly on playing field. Do not stockpile on site.

1.8 COMPLETION AND ACCEPTANCE

A. General: Field completion shall be separated into 2 phases, "Preliminary Completion" and "Substantial Completion."

B. Preliminary Completion: Scheduled date for preliminary completion shall be at least 10 calendar days before Substantial Completion. Notify the Playing Field Designer/Engineer and Owner in writing, 3 days prior to scheduled date for observation for "Preliminary Completion." To be considered "Preliminarily Complete" the following items shall be provided:

1. Stone base in place, compacted and to grade.
2. Synthetic turf installed inclusive of infill materials, field markings and logos.
3. Goal post sleeves installed.

C. Substantial Completion: After "Preliminary Completion" observation, the Playing Field Designer/Engineer and Owner shall prepare and submit to the Contractor, a punch list of items to be completed to achieve "Substantial Completion". Contractor shall notify the Playing Field Designer/Engineer and Owner in writing, 5 days prior to a requested date for a site observation to meet "Substantial Completion." To be considered "Substantially Complete" or "Playable" the following items shall be provided:

1. All "Preliminary Completion" punch list items are complete.
2. Submit five (5) copies of written operating and maintenance instructions. Provide format and contents as directed by the Engineer.
3. Submit (5) copies of all certified surveys performed during construction for Quality Control.
4. Instruct the Team or Owner's personnel in the operation of the irrigation and other systems.
5. Smooth, level playing surface level to grading tolerances.
6. Written warranties/guarantees.
7. Stockpiling or storage of required "attic stock" materials.
8. Upon completion of the synthetic field surface, the contractor shall provide the owner with 2 hours of maintenance training that shall be recorded on a video tape and supplied to the Owner.

1.9 WARRANTY/GUARANTEE

A. General: Warranties / Guarantees specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and are in addition to and run concurrent with other warranties/guarantees made by the Contractor under requirements of the Contract Documents.

B. The following are inclusive of the term "Playing Field System" for provisions of the guarantee:

1. Final grade tolerances to one-quarter inch in the length of 25' of finish grade in any direction.
2. Synthetic turf product as specified and represented by the Turf manufacturer/vendor.
3. Working functions of the drainage system.
4. All materials and products specified.
5. Topping Stone shall be guaranteed to have a percolation rate greater than 20 inches per hour.

C. Installer Guarantee: Provide in writing a "Full System Guarantee" agreement. The President(s) of the synthetic turf manufacturer (if different) shall sign this document and it shall include the following:

1. All work executed under this section will be free from defects of material and workmanship for a period of eight (8) years from date of Substantial Completion.
2. Any defects will be remedied on written notice at no additional cost to the Owner.
3. Guarantee shall include removal and replacement of materials (parts and labor) as required to repair synthetic field surfacing at no cost to the Owner.
4. The 8-year warranty shall not be prorated and be provided by third party non-cancelable insurance policy.
5. At no time in the life of the Guarantee shall the G-Max exceed 175 at any one point on the field.

D. Statement of Supervision: Upon completion of the Work, Contractor to submit a written statement signed by the synthetic turf manufacturer stating that the field supervision by the manufacturer's representative was sufficient to insure proper application of the complete system and materials, that the Work was installed in accordance with the Contract Documents, and that the installation is acceptable to the manufacturer.

E. G-Max Testing: The synthetic surface manufacturer shall retain a third party certified testing laboratory and shall perform G-Max testing during the first year of the life of the Guarantee.

1. Testing shall be performed at within 10' of mid center, at the goal locations for soccer and lacrosse, and at 10 yards inside the corners of the overlaid rectangle fields. This results in a total of 9 tests. The testing shall be performed between 90 and 120 days after substantial completion. (These tests are paid for by the Contractor).
2. Testing shall consist of shock attenuation per ASTM F-355 procedure A.
    a. G-Max shall not change more than 5% (five percent) at any one location per year over the life of the Guarantee.
        1) In cases where the results of the above testing exceed the specified values, the condition shall be corrected by the synthetic surface manufacturer. The synthetic surface manufacturer shall provide adequate information to confirm that the mitigation measures were effective.
    b. At no time in the life of the Guarantee shall the G-Max exceed 175 at any one point on the field.
3. Future testing shall be performed by a certified independent lab and paid for by the Owner.

1.10 SPARE PARTS/ATTIC STOCK

A. Stockpile Materials: Provide the following additional materials. Rubber infill shall be stored as directed by the Owner. Synthetic Turf shall be rolled out and placed on site (loose laid) as directed by the Owner.

MATERIAL	QUANTITY
Rubber Infill	2 tons
Green Synthetic Turf (2.125" pile)	450 SF (15'x30')

PART 2 – PRODUCTS

2.1 PERIMETER TURF ANCHOR/NAILER

A. The perimeter turf anchor/nailer shall be located at the field perimeter or turf edges and shall be as per drawings or approved equal.

2.2 SYNTHETIC INFILL TURF PRODUCT

A. Turf Product Specifications:

1. A UV stable, dual fiber blend (slit-film and monofilament) polyethylene fiber system.
2. Finish pile height: 2.25" min. inches.
3. Stitch gauge: ½" max on center
4. Total pile weight: 48 oz/yd^2 min
5. Permeability: 15" per hr. min.
6. G-max at install: 100-125 max.
7. G-max over life of field: 175 max.
8. All inlaid lines will be tufted in the factory to the extent practical. The use of field inlaid lines will be kept to a minimum.

B. Acceptable Turf Products:

1. Shaw "Legion Bolt"
2. Astro Turf "Rhino Blend"
3. Sprinturf "UltraBlade DFE Extreme"
4. Field Turf "Vertex Blend"
5. ACT Global "BDX50"

C. Appearance/Feel:

1. The finished playing surface shall appear as mowed grass with no irregularities and shall afford excellent traction for conventional athletic shoes of all types.
2. The finished surface shall resist abrasion and cutting from normal use.

D. Infill Materials

1.

1. Infill shall be a mixture of SBR rubber and rounded silica sand.
2. Rubber shall be dust toxics & metal free. Particle sizes shall be consistent in size and shape, between .25 and 3 mm.
3. Sand shall meet the following gradation:

SIEVE SIZE	% RETAINED
2 mm	0
.5 mm	20-30
.25 mm	40-50
.15 mm	30-40
.05 mm	5-10

4. Infill material ratios shall be as recommended by the turf system MFR.
5. The overall sand/rubber infill mix depth shall be at least 75% of the overall pile height of the installed synthetic turf system.

E. Glued seams

1. Adhesives for bonding tufted synthetic turf shall be as recommended by the synthetic turf manufacturer. Adhesives shall be one-part moisture cured polyurethane.

F. Sewn Seams:

1. Cord for sewing seam turf shall be as recommended by the synthetic turf manufacturer.

2.3 SYNTHETIC INFILL TURF MAINTENANCE EQUIPMENT

A. Provide (one) turf sweeping unit including all necessary tools and equipment to properly maintain the synthetic turf system including the alternate systems:

1. Supply a 6' wide field sweeper with magnet, which shall include a towing mechanism compatible with a field utility vehicle. The field sweeper shall be the LitterKat 760 sweeper, or equivalent.
2. Supply one turf groomer. Turf groomer shall be 6' wide and be the Sportsturf Groomer 720-SDE by Greens Groom or the G7 Groomer by Go Groomer Go, or equal.

PART 3 – EXECUTION

3.1 EXAMINATION AND PROTECTION

A. Verification of Conditions: Examine areas and conditions under which all work of this Section is being performed. Do not proceed with any work until unsatisfactory conditions have been corrected. Commencement of work implies acceptance of all areas and conditions.

B. Protection of Work: Protect all on-going work, so as not to delay work due to weather or project related construction. This includes but is not limited to the use of tarps, geotextile, plywood and other protective measures.

C. Protection of Persons and Property: Provide all necessary measures to protect workmen and passersby. Barricade open excavations occurring as part of the work, as required by municipal or other authorities having jurisdiction.

1. Protect adjacent construction throughout the entire operation. Protect newly graded areas from destruction by weather or runoff. Protect structures, utilities, pavements, and other improvements from damage caused by settlement, lateral movement, undermining and washout.

D. Unanticipated Conditions: Notify the Engineer immediately upon finding evidence of previous structures, filled materials that penetrate below designated excavation levels, or other conditions which are not shown or which cannot be reasonably assumed from existing surveys and geotechnical reports. Secure the Engineer's instruction before proceeding with further work in such areas.

E. Installation of synthetic field surfacing shall be done only after excavation and construction work which might injure it has been completed. Damage caused during construction shall be repaired before acceptance.

F. The Contractor shall coordinate the installation of the synthetic field surface and the surrounding surfaces for optimum interface at all edges.

3.2 EARTHWORK EXECUTION / SUBGRADE

A. Preparation:

1. Establish required lines, levels, contours and datum. Sports Field Contractor shall coordinate and ensure that the final grade of various materials such as the Stone Base, turf infill, etc., will result in the final field grades shown on the Contract Drawings when the complete system is installed.
2. Maintain benchmarks and other elevation control points. Re-establish, if disturbed or destroyed, at no additional cost to the Owner.
3. Establish location and extent of utilities before commencement of grading operations.
4. Surface Water Control:
    a. All earthwork operations shall be conducted in a manner to prevent surface water from infiltrating into the subgrade and base. Drainage is to be maintained in all parts of the site to drain surface water without ponding at all times. The Contractor, at his own expense, shall undercut soils saturated by ponding and backfill per this Section at the direction of the Engineer.

B. Grading:

1. The finished grade lines are shown on the contract drawings. Upon completion of this work, all debris shall be cleaned out and removed from the premises.

2. Grade Verification: Upon completion of the subgrade and topping stone, the Contractor shall provide drawings, completed by a licensed surveyor, sharing the elevations at each of the phases. Elevations shall be taken on a 25' grid across the entire field area. Tenth of a foot contours shall be shown on the submitted survey. The surveys shall be certified (signed) and submitted to the engineer for approval prior to commencing with the following steps.
3. All cutting, filling, backfilling and grading necessary shall be done to bring the area to the following grade levels:
    a. The final elevation of the subgrade surface shall be within one-half inch on a 25 foot by 25 foot grid of the interpreted finished grades indicated on the Contract Drawings. Laser controlled or indicated equipment shall be used for this part of the work.
    b. The final elevation of the topping stone surface shall be within one-quarter inch on a 25 foot by 25 foot grid of the interpreted finished grades indicated on the Contract Drawings. Laser controlled or indicated equipment shall be used for this part of the work.
    c. All surfaces shall be graded to drain to drainage structures with no ponding. Grading tolerances given above do not relieve the Contractor from this requirement.
4. Sufficient grading must be done during the progress of the work so that the entire site shall be well drained and free from water pockets.

3.3 TURF PERIMETER NAILER/ANCHOR

A. Install approved anchoring system at entire perimeter/edges of turf installation.

B. Install anchoring/nailing "collar" around other in place or installed items (quick coupler boxes, power/communication boxes, etc.), as appropriate to installation sequencing.

3.4 INSTALLATION OF STONE BASE/TOPPING STONE

A. Install tested and approved material at a uniform depth as indicated on drawings.

B. Placement of the stone base shall proceed from a stable area next to the geotextile fabric and systematically worked outward onto the field area.

1. The cover material shall be pushed forward and not dumped onto the liner.
2. Laser operated equipment shall be utilized.
3. All equipment used in spreading or traveling on the cover layer shall exert low ground pressures and shall be approved by the manufacturer and Engineer.
4. During placement and spreading,
    a. A minimum depth of 6 inches of granular material shall be maintained at all times between the fabric and wheels of trucks or spreading equipment.
    b. Dozer blades, etc. shall not make direct contact with the fabric. If tears occur in the fabric during the spreading operation, the granular material shall be cleared from the fabric and the damaged area repaired as previously described.
    c. All equipment traveling on the cover layer shall avoid making sharp turns, quick stops or quick starts.

d. Care shall be taken to not disturb, displace or damage the geotextile fabric or the drainage system.

C. Placement of the Topping Stone: This stone layer shall be placed over the stone base at an approximate depth of one-half inch to produce a level/smooth surface prior to the placement of the synthetic turf.

D. Finish grade for topping stone shall be verified using laser operated survey instrument with a tolerance of +/- one-quarter inch over 25 feet in any direction.

1. A survey of the finished spot grades is to be developed by a State licensed surveyor over the entire surface in a 25-foot grid. The survey shall be certified (signed) and submitted to the Owner and its representatives for approval prior to installing the synthetic turf.

3.5 INSTALLATION OF SYNTHETIC TURF

A. Synthetic turf shall be installed by crews employed by the Synthetic Turf manufacturer, in strict accordance with manufacturer's recommendations and instructions including but not limited to, fabric, adhesives, seaming and abutting or attaching to adjacent materials.

B. Field markings and lining of synthetic field surfacing shall be laid out as shown on the drawings and as approved by the Owner with Contractor submitted drawings.

C. Turf panel seams shall be sewn with high strength thread using a double loop stitch or glued with an adhesive as recommended by the synthetic turf manufacturer and installed per manufacturer's instructions. All seams shall be flat, tight and permanent with no separation or fraying.

D. All inlaid lines shall be backed using seaming tape with a width of 12 inches.

E. Anchor turf edges at perimeter as shown on drawings and as recommended per synthetic turf manufacturer.

F. At the end of each day, remove all scraps and other debris created by the synthetic turf installation from the playing field area.

G. Infill materials shall be applied at a uniform depth and at an ultimate finish grade tolerance of ¼ inch at any point over the entire playing field area.

H. Fiber shall not be buried or trapped below infill material when complete.

I. Anchor turf edges at field curb and at field perimeter as shown on drawings.

J. The finish turf surface shall have a permeability test performed on 5 locations on the field.

K. The permeability tests shall utilize a dual ring infiltrometer in accordance with ASTM test method. All test results on the finish infilled synthetic turf surface must be greater than 6 inches per hour.

3.6 FIELD MARKINGS

A. The field lines shall be tufted or inlaid per Owner designated sports. The final field markings shall meet the NFHSA standards as shown on the striping plan drawings.

3.7 CLEAN UP

A. Remove all surplus excavated material not required for filling and backfilling, trash, and debris and dispose of it properly off of the Owner's property at Contractor's expense.

END OF SECTION 32 18 13

SECTION 32 18 14 – SYNTHETIC TURF SUBSURFACE DRAINAGE SYSTEM

PART 1 – GENERAL

1.1 WORK INCLUDED

A. The owner has purchased the synthetic turf, rubber and sand infill materials as well as all the labor and equipment to install the synthetic turf system through a cooperative purchase agreement.

B. Contractor shall provide all labor, equipment, and materials, and do work necessary to construct the base for a synthetic turf field, as indicated on the Drawings and as specified. Work shall include but shall not be limited to:

1. Earthwork Requirements
    a. Excavation, trenching, grading, backfilling, compaction to achieve subgrade.
    b. Laser grading.
    c. Disposal of spoil materials.
    d. Acceptance of mass subgrade by Playing Field Contractor (If Different).
        1) Mass excavation performed in other contract.
        2) Playing Field Contractor to review final submittals regarding mass excavation from General Contractor.
    e. Playing Field Contractor to perform finish subgrade per this contract.
    f. Grade elevation verification of finish subgrade.
2. Drainage System Requirements
    a. Filter fabric.
    b. Gravel drainage trench fill material.
    c. Panel drain pipe, collector pipe and fittings.
    d. Stone base.
    e. Clean outs and inline structures.
    f. Grade elevation certification of finished stone base installation.

1.2 REFERENCES

A. Comply with applicable requirements of the following standards. Should the standards conflict with other specified requirements, the most restrictive requirement shall govern.

1. American Association of State Highway and Transportation Officials (AASHTO).
    a. T 89 - Determining the Liquid Limit of Soils.
    b. T 90 - Determining the Plastic Limit and Plasticity Index of Soils.
2. American Society for Testing and materials (ASTM):
    a. D 3776 - Mass Per Unit Area (Weight) of Woven Fabric.
    b. D 3786 - Hydraulic Bursting Strength of Knitted Goods and Non-Woven Fabrics: Diaphragm Bursting Strength Tester Method.
    c. D 4491 - Water Permeability of Geotextiles by Permittivity.

d. D 4533 - Trapezoid Tearing Strength of Geotextiles.
e. D 4632 - Breaking Load and Elongation of Geotextiles (Grab Method).
f. D 4833 - Index Puncture Resistance of Geotextiles, Geomembranes, & Related Products.
g. F 405 - Corrugated Polyethylene (PE) Tubing and Fittings.
h. F 449 - Subsurface Installation for Agricultural Drainage or Water Table Control.
i. F 667 - 8, 10, 12 and 15-inch Corrugated Polyethylene Tubing and Fittings.

3. Occupational Safety and Health Administration (OSHA).

1.3 DEFINITIONS

A. Excavation: Removal of material encountered to subgrade elevations indicated and subsequent disposal or placement of materials removed.

B. Unauthorized Excavation: Inadvertent or purposely removing materials beyond indicated subgrade elevations or dimensions without specific direction of the Engineer. Unauthorized excavation, as well as remedial work resulting from unauthorized excavation directed by Engineer shall be at Contractor's expense.

1. Unauthorized excavation, including disposition of additional excavated materials and other work resulting from slides, cave-ins or remedial work shall be at Contractor’s expense.

C. Additional Excavation: When excavation has reached required subgrade elevations, the Engineer will be notified and will make an observation of conditions. If Engineer determines that bearing materials at required subgrade elevations are unsuitable, excavation shall be continued until suitable bearing materials are encountered and excavated material shall be replaced as directed by the Engineer.

1. Removal of unsuitable material and its replacement as directed will be paid on basis of the Unit Price for Replacement of Unsuitable Soils provided by Contractor in its bid.

D. Subgrade: The undisturbed earth or the compacted soil layer immediately below proposed playing field drainage or soil materials. This work is being performed by the Contractor.

E. Finish subgrade: Final elevations and grading modifications to be performed in this Contract on the subgrade elevations. Playing field system to be installed above finish subgrade. This work is being performed by the Contractor.

F. Gravel Drainage material: Stone material that may be used in drainage trenches surrounding perforated drainage piping. When used below and with the stone base, this material should bridge with the stone base as described herein.

G. Base Stone: Approved stone material with the sizing and performance characteristics described herein. This stone material is installed immediately on top of the finished subgrade surface. Material could also be used in the drainage trenches if approved by the Engineer or Testing Agent.

H. Topping Stone: Approved stone material with the sizing and performance characteristics described herein. This stone material is installed immediately on top of the base stone to create a smooth surface for the placement of the synthetic turf as well as to aid in achieving finish grade tolerances of the playing field subsurface.

I. Stone Base: Final stone profile including both the base stone and topping stone.

1.4 SUBMITTALS

A. Manufacturer's Product Data: Submit manufacturer's specifications and installation instructions for all products in the playing field system, including certifications and other data as may be required to show compliance with the Contract Documents.

B. Material samples. Submit three samples each of the following:

1. Geotextile fabric approximately 7"x11".
2. Panel drain product approximately 6 inches in length, full width.
3. Aggregate Drainage Material: Provide a one-gallon sample of each gravel drainage source and for each type of gravel material to be used for testing. This could include:
   a. Base Stone.
   b. Topping Stone.
   c. Gravel Trench Stone.
   d. See Section 1.6, "Quality Control".

C. Supplier List: Submit list of procured and contracted suppliers of all materials required for this part of the Work.

D. Schedule: Work schedule for all work described in this specification section. This schedule shall be regularly updated and submitted as progress continues throughout ultimate completion.

E. Shop Drawings:

1. Sample Warranty.
2. Construction detail sketches, especially those that may deviate from the plans and specifications.

F. Playing Field Contractor Reference List:

1. Up to date contact information.
2. Responsibility/scope of work for project.
3. Similar projects – full fields.

G. Playing Field Contractor Job Superintendent Resume:

1. Similar projects and references if different that Contractor reference list.

H. Subcontractor List: Submit list of key subcontractors for the project. Briefly describe the role of each as well as their experience with similar types of facilities such as being constructed in these Documents. This list should include but is not limited to:

1. Playing Field Base Installer / Contractor.

I. Manufacturer's Review: submit written statement, signed by Contractor and synthetic field surfacing installer stating that the Drawings and Specifications have been reviewed by qualified representatives of the materials manufacturer, and that they are in agreement that the materials and system to be used for synthetic field surfacing are proper and adequate for the applications shown.

J. Site Acceptance Statements:

1. Prior to beginning Work on subgrade of playing field area: Submit a written statement signed by the General Contractor noting that the site has been reviewed and that documents showing compaction and certified elevations/planarity (if by others) have been reviewed. Note all discrepancies, conflicts or other issues. If none are found this should be noted in the statement. Upon acceptance, Work shall begin with the assurance that all work shall be warranted for the period as specified in these Documents.

K. Grade Verification: A certified survey by a State licensed surveyor shall be made of the in-place condition at the finish subgrade and finish stone base for conformance to specified elevations. Each survey shall be submitted to the Owner for acceptance prior to installation of next layer.

1.5 QUALITY ASSURANCE

A. All piping and appurtenances shall be new, clean and in accordance with material specifications, unless specifically noted on the plans.

B. Size and classification shall be shown on the plans or as specified herein.

C. The contractor who performs this work shall have installed five similar installations in the last three years. Submit complete list of projects, including project description, date of completion, and contact information. Comparable projects shall minimally include but not be exclusive to the following:

1. Laser grading (not GPS) experience for gravel and finished surface meeting the requirements for finish grade required in this Contract.
2. Installation of stone base and finished surface.
3. Full field installations.
4. Experience with testing protocols for stone base.

D. Grade Certifications: A certified survey by a State Licensed land surveyor shall be made at the top of the Finish Subgrade and at the top of the installed stone base to verify conformance to specified final elevations. GPS survey laser equipment shall not be used for any finish elevation determination. Equipment mounted laser and hub or similar are required for playing field grading operations.

1.6 QUALITY CONTROL

A. Pre-bid: Materials Inspection and Testing:

1. Bidders are encouraged to:

a. Pre-test gravel drainage materials with an independent Testing Agent prior to submitting a bid. This does not guarantee that the materials or source will be approved for construction.
b. Pre-qualify any material deviating from that specified.
c. All costs associated with pre-bid testing shall be borne by the bidder.

B. After Bid Award and Prior to construction: Submit samples of each of the following materials to establish Baseline specification and ratios for the remainder of the testing process.

1. Gravel Drainage Material: Provide a one-gallon sample of each gravel drainage source and for each type of gravel material to be used for testing. This could include:
   a. Gravel trench drainage material.
   b. Base Stone.

C. Topping Stone during Construction: Submit samples of each of the following during mass production of gravel materials for performance testing and prior to shipping.

1. Gravel Drainage / Stone / Topping Stone Material:
   a. A minimum of one-gallon sample for every 500 cubic yards of each material used shall be tested by the Testing Agent for general compliance with the established Baseline specifications.

D. Testing Agent:

1. Playing Field Testing Agent:
   a. The Testing Agent shall perform testing of the field system material components, including but not limited to stone base, topping stone and gravel trench materials, as well as to certify the capability of the stone base course to meet permeability and stability requirements before construction.
   b. The Contractor shall hire a testing agent to certify and make recommendations regarding playing field materials. Playing Field Contractor shall notify the Owner regarding timing, scheduling and use of these agents.
   c. Agent shall be independent, A2LA accredited and insured.
   d. Potential Agents for Owner Consideration
      1) Sports Labs USA, Jeff Gentile, (603)-715-5453.
      2) Turf Diagnostic and Design, Sam Ferro, (913) 723-3700.
      3) The Pennsylvania State University, Andrew McNitt, (814) 364-2792.
   e. The Testing Agent is to report/submit test results as they are known and simultaneously to the Playing Field Contractor, the Owner and its representatives.

E. The Engineer shall recommend for owner approval or rejection based on results of the tests and recommendation of the Testing Agent.

1.7 PRODUCT DELIVERY

A. Take all required measures to ensure that all piping and related appurtenances are protected from damage.

B. Special care shall be exercised during delivery and storage to avoid damage to the products.

C. All materials shall be delivered and stored within the Contractor's work limits or in an area approved by the Owner.

D. All materials shall be stored in strict accordance with the manufacturer's recommendations.

E. Products that are damaged will be removed and replaced, unless the product can be repaired in an acceptable manner by the Contractor, at his expense.

F. Packaged Materials:

1. Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery, and while stored at site. Store out of low lying or drainage areas.

G. Drainage Gravel and Stone Base:

1. Deliver tested and approved lots in clean, washed and covered trucks to eliminate contamination during transportation. Place directly on playing field. Do not stockpile on site.

1.8 WARRANTY / GUARANTEE

A. General: Warranties / Guarantees specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and are in addition to and run concurrent with other warranties/guarantees made by the Contractor under requirements of the Contract Documents.

B. The following are inclusive of the term "Playing Field System" for provisions of the guarantee:

1. Working functions of the drainage system.
2. All materials and products specified.
3. Drainage through the turf, infill and stone base shall be guaranteed to have a percolation rate of 6 inches per hour.

C. Playing Field Subsurface and Drainage System Installer Guarantee: The President/Principal of this System installer shall prepare and sign this document and it shall include the following:

1. Guarantee shall include removal and replacement of materials (parts and labor) not performing to the standards described to repair field at no cost to the Owner.

D. Contractor shall not be held liable for incidental or consequential damages.

E. The Warranty does not cover any defect, failure, damage caused by or connected with abuse, neglect, deliberate acts, acts of God, casualty or loads exceeding the Contractor's recommendations.

PART 2 – PRODUCTS

2.1 SPORTS FIELD SUBDRAINAGE SYSTEM

A. Underdrain Collector Pipe and Fittings:

1. General
   a. All specific pipes are noted on the Contract Drawings.
   b. Review drawings for locations of perforated and non-perforated piping.
   c. Solid wall pipe shall be high-density polyethylene pipe (HDPE) and shall conform to the requirements of AASHTO M252 Type S for 4 to 10 inch diameters and AASHTO M294 or ASTM F2306 Type S for 12 to 60 inch diameters.
   d. Perforated pipe shall be double wall high-density polyethylene pipe (HDPE) and shall conform to the requirements of AASHTO M252 Type SP for 4 inch to 10 inch diameters and AASHTO M294, Type SP or ASTM F2306 for 12 inch to 60 inch diameters.
   e. HDPE Perforated pipe shall have Class 2 slotted perforations in accordance with AASHTO M252 and M294.
   f. Virgin material for pipe and fitting production shall be high-density polyethylene conforming to the minimum requirements of cell classification 424420C for 4-inch to 10-inch diameters, and 435400C for 12-inch to 60-inch diameters, as defined and described in the latest version of ASTM D3350, except that carbon black content should not exceed 5%.
   g. Provide drainage pipe complete with bends, reducers, adapters, couplings, collars, and joint materials.
   h. Solid wall pipe joints and fittings shall meet the watertight joint performance requirements of AASHTO M252, AASHTO M294, or ASTM F2306. 4-inch through 60-inch shall be watertight according to the requirements of ASTM D3212. Gaskets shall be made of polyisoprene meeting the requirements of ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly.
   i. Solid wall HDPE 12-inch through 60-inch diameters shall have a reinforced bell with a bell tolerance device. The bell tolerance device shall be installed by the manufacturer.
   j. Provided drainage pipe complete with all fittings such as bends, reducers, adapters, couplings, collars, and joint materials. Fittings and couplers for perforated HDPE pipe shall be split couplings or snap couplings manufactured by the same manufacturer as the corrugated HDPE.
   k. Manufacturer’s certification according to AASHTO M252 and M294 shall be submitted to the Owner prior to installation of the pipe.
2. Products:
   a. Advanced Drainage Systems (ADS)
      1) www.ads-pipe.com
   b. Hancor, Inc.
      1) www.hancor.com
   c. Approved Equal.

B. Underdrain Panel Drains and Fittings:

1. General:
   a. Corrugated panel drain shall conform to the requirements for Class B Geocomposite as defined in ASTM D7001-06. This geocomposite product shall be composed of a flat pipe design consisting of a full circumference polyethylene core.
   b. All materials and fittings shall conform to ASTM D7001-06.
   c. The corrugated panel drain shall have a nominal thickness of 1-inch and a nominal width of 12-inch.
   d. The core shall have a minimum compressive strength of 7,500 psf.
   e. Geotextile wrap shall not be used on panel drain.
   f. Provided panel drain complete with all fittings such as bends, reducers, adapters, couplings, collars, and joint materials. All fittings shall be supplied by the same manufacturer as the panel drain.
2. Products:
   a. "AdvanEDGE" Pipe – Advanced Drainage Systems (ADS)
      1) www.ads-pipe.com
   b. "Varicor Technologies, Inc." - Multi Flow
      1) Multi-Flow.com
   c. Hancor, Inc.
      1) www.hancor.com

C. Collector Pipe Inline Drainage Structures / clean outs and sized as per drawings:

1. General:
   a. Inline structures only are to be used. Risers with fittings are not allowed.
2. Products:
   a. Cleanouts:
      1) Nyloplast Drain Basin
      2) Nyloplast Inline Drain
   b. Grate:
      1) Solid, Ductile Iron - H20 Solid
3. Open Grate - H10 Pedestrian Suppliers:
   a. Nyloplast-ADS:
      1) www.ads-pipe.com/us
   b. National Diversified Sales:
      1) www.ndspro.com
   c. Approved equal.

2.2 GEOTEXTILE FABRIC

A. General:

1. Provide on playing field subgrade and playing field drainage trenches.

2. The geotextile shall be a nonwoven sheet of plastic yarn as defined by ASTM D123 and conform to the criteria presented in the following table. These requirements shall be based on the Minimum Average Roll Value (MARV) which is defined as the value that can be expected, with 95% confidence, to be the minimum test average obtained on a roll sampled and tested in accordance with ASTM D4759.
3. Geotextile shall meet the requirements of AASHTO M288 except as modified herein.

Geotextile Class 1			
Physical Property	ASTM Procedure	Minimum Acceptance Criteria	
		English	Metric
Grab Tensile Strength	D 4632	200 lbs	890 N
Grab Elongation at Break	D 4632	50%	50%
CBR Puncture Strength	D 6241	500 lbs	2224 N
Mullen Burst Strength	D 3786	260 psi	1790 Kpa
Trapezoidal Tear	D 4533	80 lbs	355 N
Apparent Size Opening (AOS)	D 4751	70-100 US Std Sieve	150 – 212 um

4. Product:
   a. Mirafi 180 N:
      1) www.mirafi.com
   b. Propex Geotex 801:
      1) www.geotextile.com
   c. Approved equal

2.3 PERIMETER NAILER / ANCHOR

A. ACQ pressure treated lumber:

1. Conform to AWPA treatment standards for ground contact applications
2. Size per drawings

B. Anchor attachment:

1. Tapcon 3/16" x 2-3/4" Hex
2. Approved equal

2.4 STONE BASE AND TOPPING STONE

A. The stone base shall conform to the turf vendor's standard specifications subject to the Owner's approval and meet the following gradation for AASHTO #57 Stone:

1-1/2" (37.5mm)	100
1" (25.4mm)	95-100
1/2" (12.7mm)	25-80
1/4"	0-10

No. 8 (2.36mm)	0-5

B. The topping stone must conform to the turf vendor's standard specs, is subject to the Owner's approval, and meets the following gradation for No. 89 Stone:

1/2"	100
3/8"	90-100
No. 4	20-55
No. 8	0-15
No. 16	0-10
No. 50	0-5

C. All stone shall be angular. Rounded or river stone is not acceptable.

D. In no instance shall multiple quarry sources be used within a single playing field area.

E. Bridging Characteristics:

a) $3 < \frac{\text{D50 base stone}}{\text{D50 top stone}} < 6$ b) $\frac{\text{D85 top stone}}{\text{D15 base stone}} < 2$

F. Drainage Characteristics

1. Permeability for base stone shall be greater than 20"/hr.

G. Top dressing Stone is allowed for use to level the finished surface of the base stone. Total allowable finish depth to be in the range of 1/2 to 3/4 inch.

H. The gravel should meet one or both of the following stability requirements:

1. Sulfate Soundness (C-88)
   a. Not to exceed 12% loss
2. LA Abrasion (ASTM C131)
   a. Not to exceed 40

I. Alternate Gravel Backfill for Drainage Collector trenches only: Clean crushed stone or washed gravel. Gravel shall meet one or both of the above stability requirements using the stated test methods.

1. Size criteria:
   a. 95% Passing a 1 inch sieve
   b. No more than 10% passing a #10 mesh (2.0 mm) sieve
   c. No more than 5% passing a #18 mesh (1.0 mm) sieve
2. Installed below the stone base material
3. Must bridge with the stone base material.

PART 3 – EXECUTION

3.1 EXAMINATION AND PROTECTION

A. Verification of Conditions: Examine areas and conditions under which all work of this Section is being performed. Commencement of work implies acceptance of all areas and conditions. Correct any and all conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until satisfactory conditions have been corrected.

B. Protection of Work this Contract: Protect all on-going work, so as not to delay work due to weather or project related construction. This includes but is not limited to the use of tarps, geotextile, plywood and other protective measures.

C. Protection of Persons and Property: Provide all necessary measures to protect workmen and passersby. Barricade open excavations occurring as part of the work, as required by municipal or other authorities having jurisdiction.

1. Protect adjacent construction throughout the entire operation. Protect newly graded areas from destruction by weather or runoff. Protect structures, utilities, pavements, and other improvements from damage caused by settlement, lateral movement, undermining and washout.

D. Unanticipated Conditions: Notify the Owner immediately upon finding evidence of previous structures, filled materials that penetrate below designated excavation levels, or other conditions which are not shown or which cannot be reasonably assumed from existing surveys and geotechnical reports. Secure the Owner’s instruction before proceeding with further work in such areas.

E. Installation of synthetic field surfacing shall be done only after excavation and construction work which might injure it has been completed. Damage caused during construction shall be repaired before acceptance.

F. The Contractor shall coordinate the installation of the synthetic field surface and the surrounding surfaces for optimum interface at all edges.

3.2 PLAYING FIELD SUBGRADE & FINISH SUBGRADE

A. Layout and Control:

1. Refer to Section Earth Moving for subgrade work.
2. Refer to drawings for playing field limits and layout.

B. Excavation or Fill to achieve subgrade / finish subgrade if found necessary:

1. Refer to Section Earth Moving for additional Earthwork requirements

C. Playing Field Subgrade:

1. General

a. Playing Field Contractor shall perform all operations necessary to bring the playing field area to the required tolerances.
b. Subgrade shall mirror the final finish elevation of the field surface in regard to slope except where noted on the drawings.
c. Compaction shall meet 90% Standard Proctor
d. Proofrolling of the subgrade is required.
e. Sufficient grading must be done during the progress of the work so that the entire playing field area shall be well drained and free from water pockets.

2. Playing Field Subgrade Tolerance Requirements: The final elevation of the finish subgrade shall be plus or minus one half inch at any point on the field and on a 25 foot by 25 foot grid grade.
3. Playing Field Subgrade Elevation Certification: A certified survey by a State licensed land surveyor shall be performed at 25-foot grid centers to verify required grade and elevation tolerances of the finish subgrade. The digital survey document shall indicate spot elevations and tenth of foot contours and shall be submitted to the Engineer for review and approval prior to moving to next part of work.

3.3 TURF PERIMETER NAILER/ANCHOR

A. Install approved anchoring system at entire perimeter/edges of turf installation.

1. Fasten anchoring system to concrete curb or channel drain with concrete screws.
   a. Attach at all ends of the nailer boards.
   b. Anchors to be spaced 24" o.c. max.

B. Install anchoring/nailing “collar” around other in place or installed items (drain basins, cleanouts, sports equipment anchors, quick coupler boxes, etc.), as appropriate to installation sequencing.

3.4 DRAINAGE SYSTEM INSTALLATION

A. Collector Pipe Trenching:

1. Only perform trenching, drainage pipe installation and backfilling operations that can be completed in one day. Exposed trenches that collapse due to rain or other occurrences shall be widened and filled as specified or refilled with subgrade materials, compacted, and retrenched.
2. Contractor to connect playing field drainage system to site storm drainage, as indicated in the Drawings.
3. Excavate trenches for all piping to a uniform depth and width, sufficiently wide enough to provide ample working room.
   a. Minimum width of trench to be twice the pipe diameter.
   b. Abnormal conditions such as large cobbles or unstable conditions that may cause trench to lose integrity shall be reported to the Owner immediately.
4. Excavate trenches and conduit to depth indicated or required to establish indicated slope and invert elevations and to support bottom of pipe or conduit on undisturbed soil.
5. Contractor to remove or manipulate spoils from trenching excavation so that integrity of finished grade requirements is maintained prior to placing filter fabric.

B. Installation of Geotextile Filter Fabric:

1. Install filter fabric onto full extent of field, bottom and sides of trenches for collector and panel drain piping.
2. Extend fabric a minimum of 12 inches past each side of top of trench on top of the subgrade.
3. The fabric shall be placed as smooth and wrinkle-free as possible.
4. All laps shall be at least thirty-six inches in width without tension, stress, folds, or creases.
5. At time of installation, fabric will be rejected if it has defects, ribs, holes, flaws, deterioration, or damage incurred during manufacture, transportation, handling, or storage. Damaged materials shall be removed and replaced at no additional cost to the Owner.
6. Install fabric to coordinate with trenching operation and other parts of the Work.
7. Sandbags or other devices may be used as required to hold the fabric in position during installation. Materials, equipment or other items shall not be dragged across the fabric or be allowed to slide down slopes on the fabric.
8. Fabric shall be covered as soon as possible after placement to minimize exposure to sunlight and to other types of contamination such as surface run-off.
    a. Fabric shall not be exposed for more than 10 days.
    b. Fabric which becomes overly contaminated shall be removed and replaced with new fabric.
9. Contractor to temporarily fold fabric over at the tops of the trenches during construction to eliminate migration of soil materials into the gravel trench. Just prior to installation of dynamic stone base, this fold shall be undone and fabric shall be laid over the finished subgrade. Should contamination of the gravel trench occur, Contractor shall remove contaminated material and replace with clean approved materials at no cost to the Owner.

C. Installation of Collector piping:

1. Lay perforated pipe directly on drainage stone layer at trench bottom in accordance with pipe manufacturer’s recommendations.
2. Provide collars and couplings as required for installation of these lines as well as for connections to drainage structures and trench drains.
3. Install collector as indicated on drawings so that it connects to site structures or extends to limits indicated.
    a. Protect any exposed ends of pipe until connected to detention or storm sewer system by playing field Contractor or others.
4. Pipe laying work shall commence at the main collector line and shall proceed from low point of system to high point.
    a. Pipe shall be laid true to line and grade in such a manner as to assure a close concentric joint with the adjoining pipe.
    b. Protect any exposed ends of the pipe until final connections are made.
    c. After pipe installation has been observed by the Owner, drainage material shall be placed around and over the pipe.
5. Install inline structures, drain inlets, catch basins per manufacturer’s instructions.

6. After pipe installation has been observed by the Playing Field Designer/Owner, approved drainage material shall be placed around and over the pipe to the top of the trench.
    a. If observation indicates poor alignment, debris, displaced pipe, infiltration or other defects, Contractor to take whatever steps are necessary to correct such defects prior to proceeding.
7. Installation of drain lines from ground boxes:
    a. Install drain lines from in ground boxes installed in the field area. Connect directly to field drainage system or minimally to the gravel perimeter trench.
8. Collector pipe Clean Out: A nyloplast or equal structure is to be used for the cleanout. Cap shall be placed flush with finish subgrade as shown on the drawings.

D. Drainage Fill:

1. Trenches:
    a. Place approved drainage gravel fill material in the drainage trench in a single layer. Place material around drainage pipe until it is level with the surrounding subgrade. This shall be the base stone unless otherwise approved prior to installation.
    b. Contractor to consider temporarily covering top of open gravel trench with the geotextile material overlapping the top of the trench to reduce contamination of the gravel material.

E. Installation of Panel Drains:

1. Install panel drains per the manufacturer's written instruction.
2. The panel drains are to be installed directly over the top of the geotextile fabric.
3. Connect panel drains to collector/header piping using panel drain manufacturer provided fittings, per manufacturer instructions and as shown on drawings.
4. Provide 48 hours' notice to the Owner to inspect the panel drains in place prior to covering.

F. Clean Out/End Cap: Cap shall be recessed below the base stone and flush with finish subgrade elevation. Install bolt, washer and nut on cap for metal detection purposes.

G. Testing Drain Lines: The Contractor shall ensure that lines are in proper alignment and free flowing prior to placing the drainage gravel fill material. The Playing Field Designer/Owner will observe portions of this process for general conformance of the specifications.

3.5 INSTALLATION OF STONE BASE / TOPPING STONE

A. Install only tested and approved material at a uniform depth.

B. Placement of the base stone shall proceed from a stable area next to the geotextile fabric and systematically worked outward onto the field area.

1. The cover material shall be pushed forward and not dumped onto the liner.
2. Laser operated equipment shall be utilized.
3. All equipment used in spreading or traveling on the cover layer shall exert low ground pressures and shall be approved by the manufacturer and Engineer.

4. During placement and spreading:
    a. A minimum depth of 6 inches of granular material shall be maintained at all times between the fabric and wheels of trucks or spreading equipment.
    b. Dozer blades, etc. shall not make direct contact with the fabric. If tears occur in the fabric during the spreading operation, the granular material shall be cleared from the fabric and the damaged area repaired as previously described.
    c. All equipment traveling on the cover layer shall avoid making sharp turns, quick stops or quick starts.
    d. Care shall be taken to not disturb, displace or damage the geotextile fabric or the drainage system.
    e. Contractor shall install stone base layer in such a way as to reduce separation of the fines and larger particles in the stone blend.

C. Placement of the Topping Stone: This stone layer shall be placed over the stone base at a finished depth as shown on the drawings to produce a level/smooth surface prior to the placement of the synthetic turf. Due to possible drifting of this finish stone material into the stone layer below, more material may be required than the finished depth to eventually achieve finished grade elevations at the top of the finish stone layer and shall be considered as part of the overall quantities necessary.

    1. Contractor shall install topping stone layer in such a way as to reduce separation of the fines and larger particles in the stone blend.

D. Finish grade for Topping Stone:

    1. Shall be verified using laser operated survey instrument with a tolerance of +/- one-quarter inch over 25 feet in any direction.

E. Stone base elevation verification: A survey of the finished elevation for the stone base is to be developed by a State licensed surveyor over the entire surface in a 25 foot grid. The survey shall be certified (signed) and submitted to the Owner and its representatives for approval prior to installing the synthetic turf. The survey shall indicate spot elevations and tenth of foot contours.

F. Perform 4 permeability tests, in 4 different locations per full-size field, using a dual ring infiltrometer on the finished topping stone prior to installing the finished surface.

    1. All test results must be greater than 20 inches per hour.

3.6 PROTECTION

A. Protection of materials and work shall be the responsibility of the Contractor during installation and thru acceptance/substantial completion. All material damaged prior to acceptance shall be replaced at no cost to the Owner.

END OF SECTION 32 18 14

SECTION 32 18 15 – ATHLETIC CHANNEL DRAIN SYSTEM

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes install a precast, interlocking channel drainage system as specified and as shown on the working drawings.

B. System Description: Modular trench drain system precast from a corrosion resistant polymer including interlocking modular components for on-site installation.

1.2 QUALITY ASSURANCE

A. Warranty:

1. Channel drain system is included under the Project Warranty.

1.3 SUBMITTALS

A. Contractor will submit shop drawings showing a plan of the total drainage system listing all parts being provided with exact center-line dimensions suitable for installation. Copies of the manufacturer's recommended method of installation, assembly, and anchorage shall be submitted for review.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Physical and Mechanical Characteristics of Channel Units

1. Top unit width - Approximately 6.1 inches.
2. Internal width - Approximately 4.0 inches.
3. Unit invert depth - Approximately 8.8 inches.
4. Shallow channel unit invert depth – Approximately 4.6 inches.

B. Channel Profile shall include positive interlocking tongue and groove connections which can be sealed to provide watertight connections. Each precast polymer channel shall be an approximately 1-meter unit and be available in curved and straight sections.

C. Catch Basins shall be precast polymer concrete, 39.37" in length and include a plastic grating.

D. Channel Drainage System:

1. Turf to track and turf to curb applications.
   a. ACO Sport System 4020.

2. Shallow trench drain at front of home and visitors side field wall
   a. ACO Sport System 4002.
3. Track to track applications.
   a. ACO Sport System 2000

E. Grates:

1. Grates are to be black plastic with an anti-slip finish.
2. Grate locking devices are to be galvanized steel.

PART 3 – EXECUTION

3.1 SITE PREPARATION

A. Excavate the area for channel placement wide enough to accommodate the channel size with a minimum of four-inch concrete encasement. Channels require a minimum of six inches concrete support, and top of channel must be evenly aligned to the surface of the surrounding surface on both sides, as well as underneath the channel.

3.2 INSTALLATION

A. Install precast channel drain in accordance with the details on the plans and the manufacturer's instructions.

B. Channel sections are installed from the outlet ends of the system, working from the catch basins. Insert channels from above to allow ends to interlock. Channel sections shall be placed on brick, rebar basket, channel chair, low slump concrete grout slurry, or suspended to obtain correct finished elevation. Cutting will be made, if required, by masonry or concrete saw. Cover top of channel with tape, plastic, or plywood strips to protect the channel surface from concrete during pouring.

C. Finishing and Cleanup

1. Following final set of concrete, remove protection covering top of channels.
2. Install drain system in strict accordance with manufacturer's recommendations and shop drawings.

END OF SECTION 32 18 15

SECTION 32 18 23.20 – INFIELD MIX

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes installation of infield mix for the baseball/softball infield and warning track, as shown on the drawings and as specified herein.

1.2 QUALITY ASSURANCE

A. The Contractor shall provide and pay for all costs associated with the qualified Testing Engineer and Testing Laboratory to determine the conformance of the products described herein with the plans and specifications.

1.3 SUBMITTALS

A. The Contractor shall submit to the Engineer a 2-pound sample of each of the clay/sand mixture taken from the source of supply they propose to use, together with a report from an approved soil testing laboratory giving a physical analysis of the proportions of sand, clay and silt contained therein. Sample shall be labeled with Contract Name, and name of supplier. All clay/sand mixture used in the work shall conform to approved sample.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Baseball Infield Mix: "Dura Edge Classic Infield Mix," by Dura Edge. Infield mix shall conform to the following specifications:

ASTM D 698 STANDARD PROCTOR ANALYSIS	
Optimum Moisture Content	7.8.0%
Maximum Dry Density (Loose):	
LB/Cu. Ft.	133.40
TN/Cu.Yd.	1.80
Maximum Wet Density (Compacted):	
LB/Cu. Ft.	143.80
TN/Cu. Yd.	1.94

ASTM PARTICLE SIZE ANALYSIS	
SIEVE ANALYSIS SOIL CLASSIFICATION	
Sand	70%-75%
Medium, coarse, very coarse	>50%
Silt and Clay	25%-30%

B. Warning Track Mix: "Warning Track Mix" by: Dura Edge. Warning track mix shall conform to the following specifications:

ASTM D 698 STANDARD PROCTOR ANALYSIS	
Optimum Moisture Content	10.7%
Maximum Dry Density (Loose):	
LB/Cu. Ft.	120.10
TN/Cu.Yd.	1.62
Maximum Wet Density (Compacted):	
LB/Cu. Ft.	133.00
TN/Cu. Yd.	1.80

ASTM PARTICLE SIZE ANALYSIS	
SIEVE ANALYSIS SOIL CLASSIFICATION	
Sand	91%
Silt	4%
Clay	2%

C. Sand: The sand shall be clean and sharp and free from lumps and foreign matter. Sand shall conform to grading requirements as follows:

PASSING	PERCENTAGE
l/4" screen	100%
#4 screen	98 – 100%
#10 screen	90 – 98%
#18 screen	80 – 95%
#35 screen	65 – 85%
#16 screen	20 – 40%
#140 screen	0 – 10%
#270 screen	0 – 2%

D. Clay Bricks: Diamond Pro Mound/Home Plate Clay Bricks to construct pitcher's mound and catcher's and batters box areas, by Dura Edge or approved equal.

E. Mound and Home Plate Mix: Diamond Pro mound/home plate clay, 3-inch depth, by Dura Edge or approved equal.

2.2 ADDITIONAL MATERIALS

A. Contractor shall provide the 3 cubic yards of additional materials to the Owner to be stockpiled at a location approved by the Owner.

PART 3 – EXECUTION

3.1 PREPARATION

A. Coordinate Infield mix installation with the installation of irrigation, fencing, and other related items. Prior to installation of infield surfacing system, install forms to clearly delineate and limit edges of infield mixture and adjacent topsoil

3.2 INSPECTION

A. Verify that the baseball infield and warning track subbase materials have been installed in accordance with the plans and specifications, and to the grades and lines indicated.

3.3 INSTALLATION

A. The sand layer shall be spread to the depths indicated on the details and hand rolled to the required depth. The infield mix material shall be spread over the sand layer and hand rolled to the depths indicated on the details.

B. Laser grade infield mix to lines and grades indicated on the Drawings. Ensure infield mixture is flush with adjacent sodded lawn areas.

3.4 ACCEPTANCE

A. Basis of Acceptance shall be the complete installation of all skinned and warning track materials to the lines, levels, and depths indicated by the plans and specifications, demonstrated to the satisfaction of the Engineer.

3.5 CLEAN UP

A. Remove all surplus materials from the Project Site.

B. Leave the Project Site in a neat, clean condition.

END OF SECTION 32 18 23.20

SECTION 32 18 23.38 – SYNTHETIC RUNNING TRACK SURVEYING

PART 1 – GENERAL

1.1 SUMMARY

A. This section covers all labor and materials required to provide survey of key construction elements and the final track and field facility. The Contractor is responsible for completing all survey work.

1.2 CODES AND STANDARDS

A. The survey work must be completed by a licensed surveyor or engineer.

B. Codes and standards follow the current guidelines set forth by the National Federation of State High School Associations (NFSHSA).

1.3 SUBMITTALS

A. The following information must be submitted by the Contractor:

1. After installation of new precast channel drain:
    a. Survey the new precast channel drain location with elevations at:
        1) 10-meter intervals starting at the common finish line.
2. New outside and infield border curbs:
    a. Survey the outside border curbs location with elevations at:
        1) 10-meter intervals starting at the common finish line.
        2) All sprint chute corners.
        3) Elevations to show top of curb and top of notch if necessary.
    b. Survey the infield border curbs location with elevations at:
        1) 10-meter intervals.
        2) Elevations to show top of curb and top of notch.
3. After installation of all field events:
    a. Survey all field events with elevations as follows:
        1) 4 corners of all long/triple jump sand pits.
        2) Center of all long/triple jump take-off boards.
        3) Top flange of all pole vault boxes (center front and center back).
        4) 4 corners of all throw circle pads.
4. After installation of the asphalt/concrete base:
    a. Survey track oval and field event areas as follows:
        1) Both edges of all runways at 10-foot intervals.
        2) High jump area on a 20-foot grid.
        3) All paved D-zone surfaces on a 20-foot grid.
        4) Oval lanes 1, 4 and 8 at 10-meter intervals starting at the common finish line.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 32 18 23.38

SECTION 32 18 23.39 – SYNTHETIC RUNNING TRACK SURFACING

PART 1 – GENERAL

1.1 SUMMARY

A. This section covers all labor and materials required to install a first-class track & field surface. The Track & Field Synthetic Surfacing Contractor is responsible for installing all track & field synthetic surfacing materials and line markings as designated in these specifications.

1.2 CODES AND STANDARDS

A. Codes and standards follow the current guidelines set forth by the National Federation of State High School Associations (NFSHSA).

B. The following information must be submitted by the Track & Field Synthetic Surfacing Contractor prior to installation.

1. Test results, from an IAAF certified laboratory, verifying manufacturer's Track & Field Synthetic Surfacing product meets the IAAF Performance Specifications for Synthetic Surfaces.

    a. The same components from the test sample must be used in the installed surface. No substitutions will be allowed.
    b. TRRL Pendulum test results for slip resistance must be greater than 47.

2. Surfacing Contractor On-site Project Manager/Superintendent Qualifications:

    a. The project manager/superintendent for the surfacing contractor will be on-site during all surfacing operations. Substitution of project manager/superintendent shall not be permitted.
    b. A list of completed facilities, minimum of **5**, which are certified to meet NFSHSA rules & regulations in the past 5 years utilizing the product specified in these specifications. The Track & Field Synthetic Surfacing Contractor's project manager/supervisor responsible for the completed facilities must supervise this project.

3. Standard printed specifications of the track & field synthetic surfacing system that is being installed.
4. Installation process and requirements for subbase (stone, asphalt, and concrete) and any conditions that may limit the track & field synthetic surface installation or affect quality of installation.
5. Temperature/climatic conditions limiting quality of installation.
6. Standard specification and application for recommended subbase primers, crack filler, patching and leveling material.
7. Three product samples, a minimum of 6" x 6" in size, the same color, texture, thickness, etc. of the same type of surfacing to be installed for this project. This must be a representative sample of the product. This sample must be submitted and approved by

the Owner prior to installation. At completion of the project this sample may be used as a comparison to judge the quality of the installed product.

8. Material safety data sheets on all individual components of the product being installed.
9. Provide a letter stating the Track & Field Synthetic Surfacing Contractor reviewed the asphalt specification and are accepting the specification as correct. Upon completion of the Asphalt paving and prior to installation of the track & field synthetic surface, the Track & Field Synthetic Surfacing Contractor will provide a letter accepting the installed asphalt and stating it is suitable to receive the track & field synthetic surface.
10. Letter from synthetic surfacing manufacturer approving the installer/applicator of the synthetic surface listed in these specifications.
11. Written notice and acceptance that all in-ground field event equipment is installed as per the Contract Documents and the rules of the sport.

C. The following information shall be submitted after completion of the specified work:

1. Provide a copy of the Track & Field Synthetic Surface vendor's standard Warranty noting any exceptions to the Warranty information included in this Specification Section.
2. Provide a Care and Maintenance manual for the Owner's use in maintaining the synthetic surfacing.

1.3 QUALITY ASSURANCE

A. Prior to installation, or during installation or at completion of installation of the synthetic surfacing, if the Owner has any question or doubt about the quality or formulation of the material, the Track & Field Synthetic Surfacing Contractor shall have the product tested. If the product meets these specifications, then the Owner shall pay for the cost of the testing; if the product does not meet these specifications, then the Track & Field Synthetic Surfacing Contractor shall pay for the testing. Any material failing to meet specifications will be replaced with new material at the Track & Field Synthetic Surfacing Contractor’s expense.

B. Slopes and Tolerances (NFHS):

1. The maximum lateral inclination permitted for the track across the full width of the track, preferably toward the inside lane, and across all runways, shall not exceed 2:100, 2.0 percent.
2. The maximum overall downward inclination permitted in the running direction for the track, the running direction for all runways and the throwing direction for all landing sectors shall not exceed 1:1,000, 0.1 percent. Inclination shall be measured by comparing the start and end points of the races that use the straightaway portion of the oval, the last 20 meters of the javelin runway, the start and end points of other runways, not to exceed 40 meters, and the full graded length of each landing sector.
3. In the high jump approach and takeoff area, the maximum overall downward inclination shall not exceed 1:100, 1.0 percent, in the running direction toward the center of the crossbar.
4. The surface of a throwing circle shall be level.

1.4 SPECIAL PROJECT CONDITIONS

A. The Track & Field Synthetic Surfacing Contractor will provide a project manager/superintendent on-site daily through the completion of the Track & Field Synthetic Surfacing Contractor's portion of the contract.

1. The on-site project manager/superintendent shall remain on site through the completion of the project. Substitution of project manager/superintendent shall not be permitted.

B. The Track & Field Synthetic Surfacing Contractor will provide a technician that will serve as a consultant to the Owner and Contractor during the Asphalt Paving, first reviewing the asphalt specification, accepting the specification as correct, and then, providing daily review and guidance of the construction of the Asphalt Paving which will directly affect the tolerances and longevity of the eventual synthetic surfacing installation.

C. Prior to installing any concrete, the Contractor must verify with the Track & Field Synthetic Surface manufacturer if any curing compounds or agents are allowed or acceptable.

1.5 SPECIFIC SCOPE OF WORK

A. The Track & Field Synthetic Surfacing Contractor shall verify the entire track & field subbase and all events to determine that:

1. The synthetic surface for the 400 meter track oval will accurately fit onto the Asphalt Paving base.
2. That slopes and elevations meet required tolerances.
3. No bird baths exceed the allowable limits as specified.
4. The track & field areas will meet or exceed the rules of the sport.

B. The Track & Field Synthetic Surfacing Contractor shall provide all labor, materials, and equipment to perform the following work:

1. The Track & Field Synthetic Surfacing Contractor is responsible for installing all track & field synthetic surfacing materials and line markings as designated in these specifications.
2. Review Bidding documents and specifications, provide technical assistance, and approve Asphalt Paving base work as required in the specifications.
3. Review and approve installation of all field event in-ground equipment before any track & field synthetic surfacing is installed as specified and shown on the Drawings.
4. Brush and wash down all areas to be surfaced, as often as necessary during the installation of the track and field synthetic surface.
5. Repair all birdbaths as required in these specifications.
6. Install removable track & field synthetic surfacing (full pour polyurethane) plugs in all pole vault boxes, long/triple jump take-off boards (1-inch by 1-inch corner notches in one short side) and throw circles (cut plugs in half).
7. Install special material (i.e., foam, board, etc.) in slot drain opening to prevent polyurethane from entering the opening. The drainage slot opening shall be neatly trimmed out (vertical cuts), after polyurethane installation, to allow proper drainage to

occur. No polyurethane is allowed on the inside of the drainage slot opening. This shall apply only if the precast slot drain is installed.

8. Repair all damaged areas, clean-up all glue, and remove excess polyurethane, primers, and similar products. All trim cuts shall be neat and clean; on all curves the trim-out shall follow a radius line for accuracy and neatness.

1.6 WARRANTY/GUARANTEE

A. General: Warranties / Guarantees specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and are in addition to and run concurrent with other warranties/guarantees made by the Contractor under requirements of the Contract Documents.

B. The following are inclusive of the term “Track & Field Synthetic Surface” for provisions of the guarantee:

1. All slopes & tolerances as required in this specification.
2. Synthetic track & field surface product as specified and represented by the Track & Field Synthetic Surface Manufacturer.
3. All materials and products specified.
4. All line markings installed in accordance with the Contract Documents.

C. Track & Field Synthetic Surface Installer Guarantee: Provide in writing a “Full System Guarantee” agreement. The President/Principal(s) of both the Track & Field Synthetic Surface Installer and the Track & Field Synthetic Surface Manufacturer (if different) shall sign this document and it shall include the following:

1. All work executed under this section will be free from defects of material and workmanship for the specified period from date of Substantial Completion/Acceptance of the Owner.
2. Any defects will be remedied on written notice at no additional cost to the Owner.
3. The warranty shall not be prorated.
4. All material shall be guaranteed to the extent that the surfacing:

a. Has been manufactured, applied and will perform in accordance with these and the manufacturer's specifications.
b. Will hold fast and/or adhere to the primer, asphalt, concrete, edging, filler, patches, or overlay materials.
c. Is Ultra-Violet resistant, will not bubble, blister, fade, crack, or wear excessively during the warranty period.

D. The Track & Field Synthetic Surfacing Contractor shall, in the presence of the Owner, inspect the track and field synthetic surfacing each year until the end of the warranty period, or at any time requested by the Owner. Any defects in workmanship or materials (at no fault of the Owner) shall be repaired at the expense of the Track & Field Synthetic Surfacing Contractor to the satisfaction of the Owner.

E. Contractor shall not be held liable for incidental or consequential damages. The Track & Field Synthetic Surface Warranties described shall be conditioned upon:

1. Owner shall maintain track as described in the Owner's Manual submitted by the Contractor to the Owner.

F. The Warranty does not cover any defect, failure, damage caused by or connected with abuse, neglect, deliberate acts, acts of God, casualty or loads exceeding the Contractor's recommendations.

G. Warranty period to be five (5) years minimum.

PART 2 – PRODUCTS

2.1 TRACK & FIELD SYNTHETIC SURFACE

A. The track and field synthetic surface shall be as per the manufacturer's specifications, plus the following requirements and where discrepancies exist, they shall be brought to the attention of the Owner or Owner's representative prior to Bidding or Installation.

B. Colors: Manufacturer's Standard Red. Confirm final color with owner.

C. The following Products are approved for bidding:

1. Beynon Sports Surfaces:

a. Contact: John Beynon @ (410) 771-9473.
b. Product: Base Mat Structural Spray (Porous): BSS 100.

2. Advanced Polymer Technologies (APT):

a. Contact: (724) 452-1330.
b. Product: Base Mat Structural Spray (Porous): Spurtan BS.

3. Stockmeier Urethanes:

a. Contact: Medallion Athletic Products @ (704) 905-4156.
b. Product: Base Mat Structural Spray (Porous): Stobitan SC.

4. Conica USA:
a. Contact: PolySport USA @ (615) 587-7765
b. Product: Basemat Structural Spray (Porous): CONIPUR SP

D. Synthetic Track Surfacing shall be IAAF approved thickness unless otherwise specified.

E. Patching Material: All materials must be approved materials and compatible with the synthetic surface.

PART 3 – EXECUTION

3.1 INSPECTION AND ACCEPTANCE

A. Examine all surfaces and contiguous elements to receive work of this section and correct, as part of the Work of this Contract, any defects affecting installation.

B. Commencement of work will be construed as complete acceptability of surfaces and contiguous elements.

3.2 INSTALLATION REQUIREMENTS

A. The following installation requirements must be met by the Track & Field Synthetic Surfacing Contractor:

1. Installation by synthetic surface manufacturer approved project manager/superintendent applicators and technicians. Local laborers may be hired for non-technical work, only.
2. Priming - The primer shall be spray-applied in accordance with the manufacturer's specifications. Only those areas which can be installed the same day should be primed. All concrete areas to be surfaced shall receive manufacturer's approved primer.

3.3 INSTALLATION OF TRACK & FIELD SYNTHETIC SURFACE

A. Basemat Structural Spray (Porous):

1. Thickness to match sample submitted to IAAF certified testing laboratory.
2. Base Layer:
   a. The SBR granules and polyurethane shall be mixed together on site to regulate the ratio/quantity of SBR, not to exceed 82% by weight in the base mat portion of the system. The single component polyurethane binder shall be mixed with the SBR rubber so that a minimum of 20%, by weight, exists in the final mixture. This mixture is then mechanically installed using the paver.
3. Wearing layer:
   a. The 0.5 to 1.5-millimeter EPDM granules shall be mixed with polyurethane, the single-component structural spray coating. The structural spray shall be made in two (2) uniform applications.

3.4 TIMING, LIMITATIONS, AND CONDITIONS AFFECTING INSTALLATION

A. The track surfacing material shall be applied no sooner than 28 days after placement of the asphalt top course.

B. Weather and Climate: If in the opinion of the synthetic track surfacing manufacturer or the Owner, weather and climatic conditions are having or will have an adverse effect on installation; work shall be delayed until the adverse condition has passed.

C. Adjacent and Concurrent Construction: Installation shall not take place until the completion of the adjacent or concurrent construction operations which generate dust, airborne abrasives, or any other by-product that, in the opinion of the Owner or synthetic track surfacing manufacturer,

would be harmful to the track material. Under specific direction of the Owner, the Track & Field Synthetic Surfacing Contractor may be allowed to cover the track material with an approved covering if such harmful construction operations must occur after the track material has been installed.

END OF SECTION 32 18 23.39

SECTION 32 18 23.40 – SYNTHETIC RUNNING TRACK LINE MARKINGS

PART 1 – GENERAL

1.1 SUMMARY

A. This section covers all labor and materials required to install the track & field line markings.

B. The Synthetic Surface Contractor is responsible for the purchase and installation of all paints and line markings.

1.2 CODES AND STANDARDS

A. Codes and standards follow the current guidelines set forth by the National Federation of State High School Associations (NFSHSA).

1.3 SUBMITTALS

A. The following information shall be submitted prior to installation of specified work:

1. A list, similar to the one in Part 3.2 below, depicting the colors of all line markings and labels of the events to be included for approval prior to installation. Also, all symbols and markings clearly identified, illustrated, and their colors stated. The recommended NFSHSA colors shall be used.
2. Installation process and requirements for line markings and any conditions that may limit the installation or affect quality of installation.
3. Material safety data sheets on all products, as necessary.

B. The following information shall be submitted at the completion of the specified work:

1. Upon completion of all line markings, the Track & Field Synthetic Surfacing Contractor shall submit to the Owner a five (5) diagram/drawing depicting and identifying all line markings: 1) a key to the color codes, 2) a chart for all symbols, and 3) labels for all events.

PART 2 – PRODUCTS

2.1 PAINT

A. The paint shall be a metal latex based paint typically used on Track & Field Synthetic Surface.

2.2 TEMPORARY REFERENCE MARKINGS

A. These markings shall be removed at the completion of the project.

PART 3 – EXECUTION

3.1 SUMMARY

A. General line markings of the 400-meter track and field events, shall be spray applied, using only paint, primers and finishes supplied and guaranteed by the approved manufacturer and/or supplier.

B. All markings shall be in accordance with the rules of the NFSHSA and shall be certified for accuracy. The color code of the NFSHSA shall be followed.

C. No line markings shall be installed if the weather conditions are not proper (i.e., too windy).

3.2 LINE MARKINGS

A. Paint:

1. All line markings to receive adequate paint to completely cover the track & field synthetic surface.

B. Measure Line (Theoretical – not painted):

1. Track oval will not utilize a regulation curb.
2. Distance to right hand edge of the inside lane line of Lane 1 to be 20 centimeters from the measure line.

C. Line Precedence:

1. Lane lines to take precedence over other markings.
   a. Numbers and letters to be broken at all lane line intersections.
2. Waterfall starting lines take precedence over straight starting lines.
   a. Straight starting lines to taper at waterfall starting lines – maintain a 1/2-inch gap.

D. Chute Extensions:

1. Chute extension lines to be solid not dashed.
2. Break chute extension lies 2 inches either side of track oval lines.

E. 100 Meters:

1. Two Directions – main straight away.
2. Event label:
   a. 100.
   b. 4 inches high.
   c. The color of the label to be white.
   d. Located in the outside lane and is above the starting line.
3. Color of starting line is white.

F. 100 Meter Hurdles:

1. Two Directions – main straight away.
2. Event label:
   a. 100.
   b. 4 inches high.
   c. The color of the label to be white.
   d. Located in the outside lane and is above the starting line.
3. Color of the starting line is white.
4. The hurdle tic marks are yellow.
   a. Hurdle tic marks are a 2.5-inches wide by 3 inches high triangle, the triangle is pointing in the direction of running – Each lane shall have 2 tic marks with each tic mark adjacent to the lane line, but not touching the lane line.

G. 110 Meter Hurdles:

1. Two Directions – main straight away.
2. Event label:
   a. 110.
   b. 4 inches high.
   c. The color of the label to be white.
   d. Located in the outside lane and is above the starting line.
3. Color of the starting line is white.
4. The hurdle tic marks are blue.
   a. Hurdle tic marks are a 2.5-inches wide by 3 inches high triangle, the triangle is pointing in the direction of running – Each lane shall have 2 tic marks with each tic mark adjacent to the lane line, but not touching the lane line.

H. 200 Meters:

1. All in lanes.
2. Event label:
   a. 200.
   b. 4 inches high.
   c. The color of the label to be white.
   d. Located in Lane 2 and is above the starting line.
3. Color of the starting line is white.

I. 400 Meters:

1. All in lanes.
2. Event label:
   a. 400.
   b. 4 inches high.
   c. The color of the label to be white.

d. Located in Lane 2 and is above the starting line.

3. Color of the starting line is white.

J. 300 Meter Hurdles:

1. All in lanes.
2. Event label:
   a. 300.
   b. 4 inches high.
   c. The color of the label to be white.
   d. Located in lane 2 and is above the starting line.
3. Color of the starting line is white.
4. The hurdle tic marks are red.
   a. Hurdle tic marks are a 2.5-inches wide by 3 inches high triangle, the triangle is pointing in the direction of running – Each lane shall have 2 tic marks with each tic mark adjacent to the lane line, but not touching the lane line.

K. 800 Meters:

1. Waterfall start and 1 turn stagger.
2. Event label:
   a. 800.
   b. 4 inches high.
   c. The color of the label to be white.
   d. The 1 turn stagger starting line is located in Lane 2, the waterfall starting line is located in the outside lane, and the labels are above the starting line.
3. Color of the 1 turn stagger starting line is white with a green insert.
4. The color of the waterfall starting line is white.

L. 1600 Meters:

1. Waterfall start.
2. Event label:
   a. 1600.
   b. 4 inches high.
   c. The color of the label to be white.
   d. Located in the outside lane and is above the starting line.
3. Color of the starting line is white.

M. 1-Mile Run:

1. Waterfall start.
2. Event label:
   a. 1 mile.
   b. 4 inches high.

c. The color of the label to be white.
d. Located in the outside lane and is above the starting line.

3. Color of the starting line is white.
4. Install 1-inch wide by 3-inch long white marks on the infield side of the inside lane line at the 3/4, 1/2, and 1/4 marks.

N. 3200 Meters:

1. Waterfall start.
2. Event label:
   a. 3200.
   b. 4 inches high.
   c. The color of the label to be white.
   d. Located in the outside lane and is above the starting line.
3. Color of the starting line is white.

O. 400 Meter Relay:

1. All in lanes.
2. Event label:
   a. 400.
   b. 4 inches high.

   c. The color of the label to be white.
   d. Located in lane 2 and is above the starting line.
3. Color of the starting line is white, same starting line as the staggered starting line for the 400 meters.
4. The relay exchange zone markers are yellow and the acceleration zone marker is yellow.
   a. Exchange zone markers are 36-inch wide by 18-inch high triangles, the two triangles point into the relay exchange zone, and the triangles are included in the 20-meter zone
   b. Acceleration zone mark is 6-inch wide by 6-inch high triangle; one triangle per lane, 10 meters before the exchange zone marker, and the triangle is included in the 10-meter acceleration zone

P. 800 Meter Relay:

1. Four turn stagger.
2. Event label:
   a. 800R.
   b. 4 inches high.
   c. The color of the label to be white.
   d. Located in lane 2 and is above the starting line.
3. Color of the starting line is white with a red insert.
4. The relay exchange zone markers are red.

a. Exchange zone markers are 36-inch wide by 18-inch high triangles, the two triangles point into the relay exchange zone, and the triangles are included in the 20-meter zone

Q. 1600 Meter Relay:

1. Three turn stagger.
2. Event label:
   a. 1600R.
   b. 4 inches high.
   c. The color of the label to be white.
   d. Located in lane 2 and is above the starting line.
3. Color of the starting line is white with a blue insert.
4. The relay exchange zone markers are blue.
   a. Exchange zone markers are 36-inch wide by 18-inch high triangles, the two triangles point into the relay exchange zone, and the triangles are included in the 20-meter zone.

R. 3200 Meter Relay:

1. One turn stagger.
2. Event label:
   a. 3200R.
   b. 4 inches high.
   c. The color of the label to be white.
   d. Located in lane 2 and is above the starting line.
3. Color of the starting line is white with a green insert.
4. The relay exchange zone markers are green.
   a. Exchange zone markers are 36-inch wide by 18-inch high triangles, the two triangles point into the relay exchange zone, and the triangles are included in the 20-meter zone.

S. Break Lines:

1. The break line shall be a solid green arc line per Rule, Section 1, Article 10.
2. Provide green dashes on the inside lane line of Lane 5 from box alley 2 start to break lines (both turns).

T. Finish Line:

1. Location:
   a. Common: Located at the point of curvature (PC) per plan.
2. 2 inches wide and white in color.
3. The intersection of the finish line with the lane lines shall be painted to conform with the current NCAA recommendation
4. No lean line is to be provided.

U. Box Alleys:

1. Provide 1-turn box alley starts for the following events:
   a. 800.
   b. 1600.
   c. 3200.
2. Box 1 to be lanes 1 through 4.
3. Box 2 to be lanes 5 through 8.

V. Long/Triple Jump:

1. Runway lines:
   a. 2-inch wide lines.
   b. White in color.
   c. 48-inch wide runways (inside edge to inside edge of line).
2. Distance marks:
   a. Provide 1.5-inch long by 1-inch wide white lines outside the runway on the right hand (direction of running) side every foot beginning at 20 feet from the long jump foul line and extending the length of the runway or 150 feet, whichever is shorter.
   b. Every 5- and 10-foot line to be 3 inches long by 1 inch wide.
   c. Every 10-foot line to be labeled below the line facing the athlete.

W. Pole Vault:

1. Runway lines:
   a. 2-inch wide lines.
   b. White in color.
   c. 48-inch wide runways (inside edge to inside edge of line).
   d. Terminate runway lines at zero line.
2. Zero line:
   a. 1/2-inch wide line.
   b. White in color.
   c. 24-foot long centered on back edge of box (not flange).
3. Marks:
   a. Provide 36-inch long by 2-inch wide white line with label beside the line in the center of the runway at 12 feet from the back of the plant box.
   b. Provide 12-inch long by 2-inch wide white lines in the center of the runway at 9, 10, 11, 13, 14, and 15 feet from the back of the plant box. Dimension labels to be placed outside the runway line.
4. Distance marks:
   a. Provide 1.5-inch long by 1-inch wide white lines outside the runway on the right-hand side (direction of running) every foot beginning at 15 feet from the plant box and extending the length of the runway or 150 feet whichever is shorter.
   b. Every 5- and 10-foot line to be 3 inches long by 1 inch wide.
   c. Every 10-foot line to be labeled below the line facing the athlete.

X. Shotput:

1. Dividing lines:
   a. 2-inch wide lines.
   b. White in color.
   c. Back edge of line to be on centerline of throw circle.
   d. Extend 2.46 feet from edge of throw circle.
2. Sector Lines:
   a. To be at angle of 34.92 degrees.
   b. 2-inch wide lines.
   c. White in color.
   d. Outside the recessed throwing circle.
   e. Install 2-inch wide sector lines to the end of the landing area.

Y. Discus:

1. Dividing lines:
   a. 2-inch wide lines.
   b. White in color.
   c. Back edge of line to be on centerline of throw circle.
   d. Extend 2.46 feet from edge of throw circle.
2. Sector Lines:
   a. To be at angle of 34.92 degrees.
   b. 2-inch wide lines.
   c. White in color.
   d. Outside the recessed throwing circle.

Z. Lane numbers:

1. The numbers are a block style, 24 inches high, and the numbers will not have a color shadow.
2. The color of the numbers will be white.
3. There are 5 sets of numbers:
   a. There is 1 set of numbers 5 feet before the 110M starting line.
   b. There is 1 set of numbers 1 foot after the common finish line, facing to the outside of the track oval.
   c. There is 1 set of numbers staggered in the first turn, above the 400M staggers.
   d. There is 1 set of numbers staggered at the 300M, above the starting line.
   e. There is 1 set of numbers staggered at the 200M, above the starting line.

AA. Interval Marks:

1. Provide a 2-inch wide white line on the inside of the track oval extending from the inside edge of the inside Lane 1 line approximately 4 inches long.

2. These lines are to be at 50-meter intervals starting at the common finish line and running the entire length of the track oval.

BB. All color markings listed above must be reviewed and verified as correct, as per the rules and regulations of the governing body.

Note: All line markings must be reviewed and verified with the Owner's representative prior to installation.

END OF SECTION 32 18 23.40

SECTION 32 18 23.41 – SYNTHETIC RUNNING TRACK CERTIFICATION SURVEY

PART 1 – GENERAL

1.1 SUMMARY

A. This section covers all labor and materials required to provide certification of the final track & field facility. The Contractor is responsible for completing all survey work.

1.2 CODES AND STANDARDS

A. The survey work must be completed by a licensed surveyor.

B. Codes and standards follow the current guidelines set forth by the National Federation of State High School Associations (NFSHSA).

1.3 SUBMITTALS

A. The following information must be submitted by the Contractor:

1. After installation of the track & field synthetic surface and line markings:
   a. The Contractor shall submit the below Track & Field Certification Survey, stating the completed facility meets requirements outlined in the NFSHSA Rulebook. The Engineer or Surveyor, selected by the Contractor, must survey the facility's as-built line markings.

B. Certification Survey:

1. Facility Information:

Owner _____

Facility Name _____

Location _____

2. Surveyor/Engineer Information:

Firm Name _____

Contact _____

Phone # _____

Registration # _____

3. Survey Information:

Date of Survey _____

Weather Conditions _____

1.4 TRACK OVAL MEASUREMENTS

A. Contractor shall provide for Engineer's review a completed Class 4 Markings Certification for Running Tracks per the latest ASBA (American Sports Builders Association) Construction and Maintenance Manual.

B. The track survey and certification form shall be completed and stamped and signed by a licensed surveyor and the surveyor shall have provided similar work for at least 5 running tracks in the last 5 years.

END OF SECTION 32 18 23.41

SECTION 32 32 13

CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 SUMMARY

The work under this section consists, in general, of furnishing all labor, materials, tools, equipment, and incidentals for providing chain-link fencing and gates indicated on the project drawings and as specified herein.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM B 117	(2003) Standing Practice for Operating Salt Spray (Fog) Apparatus
ASTM C 94/C 94M	(2006) Standard Specification for Ready-Mixed Concrete
ASTM F 1043	(2004) Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework
ASTM F 883	(2004) Padlocks
ASTM G 23	(1996) Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials
ASTM G 26	(1996) Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials
ASTM G 53	(1996) Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS RR-F-191	(Rev K) Fencing, Wire and Post Metal (and Gates, Chain-Link Fence Fabric, and Accessories)
FS RR-F-191/1	(Rev D) Fencing, Wire and Post, Metal (Chain-Link Fence Fabric)
FS RR-F-191/2	(Rev D) Fencing, Wire and Post, Metal (Chain-Link Fence Gates)
FS RR-F-191/3	(Rev D) Fencing, Wire and Post, Metal (Chain-Link Fence Posts, Top Rails and Braces)

FS RR-F-191/4	(Rev D) Fencing, Wire and Post, Metal (Chain-Link Fence Accessories)

1.3 SUBMITTALS

The following shall be submitted in accordance with, “Submittals.”

A. Shop Drawings

1. Gates
2. Post spacing
3. Location of gate, corner, end, and pull posts

B. Product Data

1. Chain-link fencing components
2. Accessories

C. Test Reports

1. Chemical composition and thickness of aluminum alloy coating

D. Certificates

1. Fabric
2. Posts
3. Braces
4. Framing
5. Rails
6. Tension wires
7. Gates

E. Manufacturer's Instructions

1. Fence
2. Turnstiles

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials to site in an undamaged condition. Store materials off the ground to provide protection against oxidation caused by ground contact.

1.5 QUALITY ASSURANCE

1.5.1 Required Report Data

Submit reports of listing of chain-link fencing and accessories regarding chemical composition and thickness of aluminum alloy coating.

PART 2 - PRODUCTS

2.1 CHAIN-LINK FENCING AND ACCESSORIES

FS RR-F-191 and detailed specifications as referenced and other requirements as specified.

2.1.1 Fabric

FS RR-F-191/1; Type II, aluminum-coated steel, 9 gage. Mesh size, 2 inches. Provide selvage twisted and barbed at both selvages. Height of fabric, as indicated.

2.1.2 Gates

FS RR-F-191/2; Type II, double swing. Shape and size of gate frame, as indicated. Framing and bracing members, round or square of steel. Steel member finish, zinc-coated. Gate frames and braces of minimum sizes listed in FS RR-F-191/3 for each Class and Grade except that steel pipe frames shall be 1.90 inches od, 0.120 inches minimum wall thickness. Gate fabric, as specified for fencing fabric. Coating for steel latches, stops, hinges, keepers, and accessories. Gate latches, plunger bar type. Gate leaves less than 8 feet wide shall have truss rods or intermediate braces. Attach gate fabric to gate frame in accordance with manufacturer's standards, except that welding will not be permitted. Arrange padlocking latches to be accessible from both sides of gate, regardless of latching arrangement.

2.1.3 Posts, Bottom Rails and Braces

FS RR-F-191/3 line posts; Class 1, steel pipe, Grade A. End, corner, and pull posts; Class 1, steel pipe, Grade A in minimum sizes listed in FS RR-F-191/3 for each class and grade.

2.1.4 Fencing Accessories

FS RR-F-191/4. Provide wire ties constructed of the same material as the fencing fabric.

2.1.6 Concrete

ASTM C 94/C 94M, using 3/4 inch maximum-size aggregate, and having minimum compressive strength of 3000 psi at 28 days.

2.1.7 Grout

Provide grout of proportions one part portland cement to three parts clean, well-graded sand and a minimum amount of water to produce a workable mix.

PART 3 - EXECUTION

3.1 SITE PREPARATION

3.1.1 Clearing and Grading

Clear fence line of trees, brush, and other obstacles to install fencing. Area within 10 feet on the front and back of the fence shall be cleared and grubbed prior to fence installation. Establish a

graded, compacted fence line prior to fencing installation. Use compacted backfill as necessary to establish fence line.

3.1.2 Excavation

Excavate to dimensions indicated for concrete-embedded items, except in bedrock. If bedrock is encountered, continue excavation to depth indicated or 18 inches into bedrock, whichever is less, with a diameter in bedrock a minimum of 2 inches larger than outside diameter of post. Clear post holes of loose material. Dispose of waste material as directed.

3.2 FENCE INSTALLATION

Install fence on prepared surfaces to line and grade indicated. Secure fastening and hinge hardware in place to fence framework by peening or welding. Allow for proper operation of components. Coat peened or welded areas with a repair coating matching original coating. Install `fence` in accordance with fence manufacturer's written installation instructions except as modified herein.

3.2.1 Post Spacing

Provide line posts spaced equidistantly apart, not exceeding 10 feet on center. Provide gate posts spaced as necessary for size of gate openings. Do not exceed 500 feet on straight runs between braced posts. Provide corner or pull posts, with bracing in both directions, for changes in direction of 15 degrees or more, or for abrupt changes in grade. Provide drawings showing location of gate, corner, end, and pull posts.

3.2.2 Post Setting

Set posts plumb. Allow concrete and grout to cure a minimum of 72 hours before performing other work on posts.

3.2.2.1 Earth and Bedrock

Provide concrete bases of dimensions indicated. Compact concrete to eliminate voids, and finish to a dome shape.

3.2.3 Bracing

Brace gate, corner, end, and pull posts to nearest post with a horizontal brace used as a compression member, placed at least 12 inches below top of fence, and a diagonal truss rod and truss tightener used as a tension member.

3.2.4 Bottom Rails

Install bottom rails before installing chain-link fabric. Pass top rail through intermediate post caps. Provide expansion coupling spaced as indicated.

3.2.5 Top Tension Wires

Install top tension wires before installing chain-link fabric, and pull wires taut. Place top and bottom tension wires within 8 inches of respective fabric line.

3.2.6 Fabric

Pull fabric taut and secure fabric to bottom rail and top wire, close to both sides of each post and at maximum intervals of 24 inches on center. Secure fabric to posts using stretcher bars, ties or clips spaced 15 inches on center, or by integrally weaving to integral fastening loops of end, corner, pull, and gate posts for full length of each post. Install fabric on opposite side of posts from area being secured. Install fabric so that bottom of fabric is no more than 2 inches above ground level. Install fence fabric to provide approximately 2 inch deflection at center of fabric span between two posts, when a force of approximately 30 pounds is applied perpendicular to fabric. Fabric should return to its original position when force is removed.

3.3 ACCESSORIES INSTALLATION

3.3.1 Post Caps

Install post caps as recommended by the manufacturer. Cap shall be riveted to post to prevent excessive movement and noise. Studs driven by low-velocity powder-actuated tools may be used with steel, wrought iron, ductile iron, or malleable iron. Do not use studs driven by powder-actuated tools with gray iron or other material that will fracture.

3.3.2 Supporting Arms

Install supporting arms as recommended by manufacturer. In addition to manufacturer's standard connections, permanently secure supporting arms to posts. Studs driven by low-velocity powder-actuated tools may be used with steel, wrought iron, ductile iron, or malleable iron. Do not use studs driven by powder-actuated tools with gray iron or other material that will fracture.

3.3.3 Omitted

3.3.4 Gates

Install swing gates to swing through 180 degrees from closed to open. Additionally, at each location where the gate is located across a paved section the Contractor shall install two (2) 1-inch diameter electrical conduits below grade. The conduits shall stub up at both ends of the gate at the location of the post. Each conduit shall be capped and shall extend 6 inches above grade. Conduit shall be installed below pavement section.

3.4 GROUNDING

Ground fencing as recommended by the manufacturer and as specified in Division 16.

3.5 SECURITY

Install new security fencing, remove existing security fencing, and perform related work to provide continuous security for facility. Schedule and fully coordinate work with the Owner.

3.6 CLEANUP

Remove waste fencing materials and other debris from the project site.

End of Section 32 31 13

SECTION 32 31 19 - DECORATIVE METAL FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Decorative metallic-coated-steel tubular picket fences.
2. Swing gates.
3. Gate operators, including controls.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For fencing and gates.

1. Include plans, elevations, sections, gate locations, post spacing, and mounting attachment details.
2. Gate Operator: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
3. Wiring Diagrams: Include diagrams for power, signal, and control wiring.

C. Samples: For each fence material and for each color specified.

1. Provide Samples 12 inches in length for linear materials.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Wind Loading:

1. Fence Height: 0 to 15 feet.
2. Wind Exposure Category: As indicated on Drawings.
3. Design Wind Speed: As indicated on Drawings.
4. Design Wind Pressure: As indicated on Drawings.

2.2 DECORATIVE METALLIC-COATED-STEEL TUBULAR PICKET FENCES

A. Decorative Metallic-Coated-Steel Tubular Picket Fences: Comply with ASTM F2408 for light-industrial (commercial) application (class) unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ameristar Fence - “Aegis II G3” (Basis of Design)
b. Master Halco
c. Betafence - UpGrade-I

B. Posts:

1. End and Corner Posts: Square tubes 3 by 3 inches formed from 0.108-inch nominal-thickness, metallic-coated steel sheet or formed from 0.105-inch nominal-thickness steel sheet and hot-dip galvanized after fabrication.
2. Posts at Swing Gate Openings: Square steel tubing 3 by 3 inches with 3/16-inch wall thickness, hot-dip galvanized.

C. Post Caps: UV-resistant plastic.

D. Rails: Square tubes or Double-wall channels.

1. Size: 1-3/4 by 1-3/4 inches.
2. Metal and Thickness: 0.079-inch nominal-thickness, metallic-coated steel sheet or 0.075-inch nominal-thickness, uncoated steel sheet, hot-dip galvanized after fabrication.

E. Pickets: Square tubes.

1. Extend pickets beyond top rail as indicated and press flat and trim to produce spear point shape.
2. Picket Spacing: 4 inches clear, maximum.

F. Fasteners: Manufacturer's standard concealed fastening system.

G. Metallic-Coated Steel Sheet: Galvanized-steel sheet or aluminum-zinc, alloy-coated steel sheet.

H. Interior surface of tubes formed from uncoated steel sheet shall be coated with zinc-rich thermosetting coating to comply with ASTM F2408.

I. Galvanizing: For components indicated to be galvanized and for which galvanized coating is not specified in ASTM F2408, hot-dip galvanize to comply with ASTM A123/A123M. For hardware items, hot-dip galvanize to comply with ASTM A153/A153M.

J. Finish: Powder coating over galvanizing.

2.3 SWING GATES

A. Gate Configuration: As indicated on Drawings.

B. Gate Frame Height: As indicated on Drawings.

C. Gate Opening Width: As indicated on Drawings.

D. Automated vehicular gates shall comply with ASTM F2200, Class II.

E. Aluminum Frames and Bracing: Fabricate members from square extruded-aluminum tubes 2 by 2 inches with 0.125-inch wall thickness.

F. Frame Corner Construction: Welded.

G. Additional Rails: Provide as indicated, complying with requirements for fence rails.

H. Infill: Comply with requirements for adjacent fence.

I. Picket Size, Configuration, and Spacing: Comply with requirements for adjacent fence.

J. Hardware: Latches permitting operation from both sides of gate, hinges, and keepers for each gate leaf more than 5 feet wide. Provide center gate stops and cane bolts for pairs of gates.

K. Hinges: BHMA A156.1, Grade 1, suitable for exterior use.

1. Function: 39 - Full surface, triple weight, antifriction bearing.
2. Material: Wrought steel, forged steel, cast steel, or malleable iron; galvanized.

L. Rim Locks: BHMA A156.5, Grade 1, suitable for exterior use.

1. Material: Cast, forged, or extruded brass or bronze.
2. Mounting Plate: Configuration necessary for mounting locks. Fabricate from 1/8-inch-thick, steel plate; galvanized.

M. Electric Strikes: BHMA A156.31, Grade 1, of configuration required for use with lock specified, fail-safe -secure, and suitable for exterior use.

1. Mounting Plate: Configuration necessary for mounting electric strikes. Fabricate from 1/8-inch- thick, steel plate; galvanized.

2. Mounting: Mortise into post.

N. Exit Hardware: BHMA A156.3, Grade 1, Type 1 (rim exit device), with push pad actuating bar, suitable for exterior use.

1. Mounting Channel: Bent-plate channel formed from 1/8-inch- thick, steel plate. Channel spans gate frame. Exit device is mounted on channel web, recessed between flanges, with flanges extending 1/8 inch beyond push pad surface.

O. Cane Bolts: Provide for inactive leaf of pairs of gates. Fabricated from 3/4-inch- diameter, round steel bars, hot-dip galvanized after fabrication. Finish to match gates. Provide galvanized-steel pipe strikes to receive cane bolts in both open and closed positions.

P. Finish exposed welds to comply with NOMMA Guideline 1, Finish #2 - completely sanded joint, some undercutting and pinholes okay.

Q. Galvanizing: For items other than hardware that are indicated to be galvanized, hot-dip galvanize to comply with ASTM A123/A123M. For hardware items, hot-dip galvanize to comply with ASTM A153/A153M.

R. Steel Finish: High-performance coating.

2.4 GATE OPERATORS

A. Provide factory-assembled automatic operating system designed for gate size, type, weight, and operation frequency. Provide operation control system with characteristics suitable for Project conditions, with remote-control stations, safety devices, and weatherproof enclosures; coordinate electrical requirements with building electrical system.

1. Provide operator designed so motor may be removed without disturbing limit-switch adjustment and without affecting auxiliary emergency operator.
2. Provide operator with UL approval.
3. Provide electronic components with built-in troubleshooting diagnostic feature.
4. Provide unit designed and wired for both right-hand/left-hand opening, permitting universal installation.

B. Comply with NFPA 70.

C. UL Standard: Manufacturer and label gate operators to comply with UL 325.

D. Emergency Access Requirements: Comply with requirements of authorities having jurisdiction for automatic gate operators on gates that must provide emergency access.

E. Motor Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, within installed environment, with indicated operating sequence, and without exceeding nameplate rating or considering service factor. Comply with NEMA MG 1 and the following:

1. Voltage: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.

2. Horsepower: Not less than [1/2].
3. Enclosure: Totally enclosed.
4. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.
5. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.
6. Phase: One.

F. Gate Operators: Gate mounted and as follows:

1. Mechanical Swing Gate Operators:

a. Duty: Heavy duty, commercial/industrial.
b. Gate Speed: Minimum 45 feet per minute.
c. Frequency of Use: Continuous duty.
d. Operating Type: Crank arm, with manual release.
e. Drive Type: Enclosed worm gear and chain-and-sprocket reducers, roller-chain drive.
f. Pedestal mount, sized to the weight of the gate plus 15% but not less than ¾ hp.

G. Remote Controls: Electric controls separated from gate and motor and drive mechanism, with NEMA ICS 6, Type 1 enclosure for pedestal mounting, and with space for additional optional equipment. Provide the following remote-control device(s):

1. Card Reader: Functions only when authorized card is presented. Programmable, multiple -code system ; face-lighted unit fully visible at night.

a. Reader Type: Proximity.
b. Features: Capable of monitoring and auditing gate activity.
c. Reader shall work with Owner’s existing badge card system.

2. Radio Control: Digital system consisting of code-compatible universal receiver for each gate with remote antenna with coaxial cable and mounting brackets designed to operate gates. Provide twoprogrammable transmitter(s) with multiple-code capability permitting validating or voiding of not less than 1000codes per channel configured for the following functions:

a. Transmitters: Single button operated, with open and close function.
b. Channel Settings: Four independent channel settings controlling separate receivers for operating more than one gate from each transmitter.

H. Vehicle Loop Detector: System includes automatic closing timer with adjustable time delay, timer cutoff switch, and loop detector designed to hold gate open until traffic clears. System includes electronic detector with adjustable detection patterns, adjustable sensitivity and frequency settings, and panel indicator light designed to detect presence or transit of a vehicle over an embedded loop of wire and to emit a signal activating the gate operator. System includes number of loops consisting of multiple strands of wire, number of turns, loop size, and method of placement, as recommended in writing by detection system manufacturer for function indicated, at location indicated on Drawings.

I. Obstruction Detection Devices: Provide each motorized gate with automatic safety sensor(s). Activation of sensor(s) causes operator to immediately function as follows:

1. Action: Reverse gate in both opening and closing cycles, and hold until clear of obstruction.
2. Internal Sensor: Built-in torque or current monitor senses gate is obstructed.

J. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop gate at fully retracted and fully extended positions.

K. Emergency Release Mechanism: Quick-disconnect release of operator drive system of the following type, permitting manual operation if operator fails. Design system so control-circuit power is disconnected during manual operation.

1. Type: Mechanical device, key, or crank-activated release.

L. Operating Features:

1. Digital Microprocessor Control: Electronic programmable means for setting, changing, and adjusting control features with capability for monitoring and auditing gate activity. Provide unit that is isolated from voltage spikes and surges.
2. System Integration: With controlling circuit board capable of accepting any type of input from external devices.
3. Master/Slave Capability: Control stations designed and wired for gate pair operation.
4. Automatic Closing Timer: With adjustable time delay before closing and timer cutoff switch.
5. Open Override Circuit: Designed to override closing commands.
6. Reversal Time Delay: Designed to protect gate system from shock load on reversal in both directions.
7. Maximum Run Timer: Designed to prevent damage to gate system by shutting down system if normal time to open gate is exceeded.
8. Clock Timer: 24-hour Seven-day programmable for regular events.

M. Accessories:

1. Warning Module: Audio, strobe-light alarm sounding three to five seconds in advance of gate operation and continuing until gate stops moving; compliant with the United States Access Board's ADA-ABA Accessibility Guidelines.
2. Battery Backup System: Battery-powered drive and access-control system, independent of primary drive system.

    a. Fail-Safe: Gate opens and remains open until power is restored.
    b. Fail-Secure: Gate cycles on battery power, then fail-safe when battery is discharged.

3. External electric-powered solenoid lock with delay timer allowing time for lock to release before gate operates.
4. Fire box.
5. Instructional, Safety, and Warning Labels and Signs: According to UL 325.

6. Equipment Bases/Pads: Precast concrete, depth not less than 12 inches, dimensioned and reinforced according to gate operator component manufacturer's written instructions and as indicated on Drawings.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Concrete: Normal-weight, air-entrained, ready-mix concrete complying with requirements in Section 03 30 00 "Cast-in-Place Concrete" with a minimum 28-day compressive strength of 3000 psi, 3-inch slump, and 1-inch maximum aggregate size or dry, packaged, normal-weight concrete mix complying with ASTM C387/C387M mixed with potable water according to manufacturer's written instructions.

C. Nonshrink Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M and specifically recommended by manufacturer for exterior applications.

2.6 METALLIC-COATED-STEEL FINISHES

A. Surface Preparation: Clean surfaces of oil and other contaminants. Use cleaning methods that do not leave residue. After cleaning, apply a zinc-phosphate conversion coating compatible with the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and apply galvanizing repair paint, complying with SSPC-Paint 20, to comply with ASTM A780/A780M.

B. Powder Coating: Immediately after cleaning and pretreating, apply manufacturer's standard TGIC polyester powder-coat finish to a minimum dry film thickness of 2 mils.

1. Color and Gloss: As selected by Design Professional from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, construction layout, and other conditions affecting performance of the Work.

B. Do not begin installation before final grading is completed unless otherwise permitted by Design Professional.

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

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

1. Construction layout and field engineering are specified in Section 01 73 00 "Execution."

3.3 DECORATIVE FENCE INSTALLATION

A. Install fences according to manufacturer's written instructions.

B. Install fences by setting posts as indicated and fastening rails and infill panels to posts. Peen threads of bolts after assembly to prevent removal.

C. Post Excavation: Drill or hand-excavate holes for posts in firm, undisturbed soil. Excavate holes to a diameter of not less than 4 times post size and a depth of not less than 24 inches plus 3 inches for each foot or fraction of a foot that fence height exceeds 4 feet.

D. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.

1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
2. Concrete Fill: Place concrete around posts and sleeves and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.

    a. Concealed Concrete: Top 2 inches below grade to allow covering with surface material. Slope top surface of concrete to drain water away from post.

3. Posts Set in Concrete: Extend post to within 6 inches of specified excavation depth, but not closer than 3 inches to bottom of concrete.
4. Space posts uniformly at 8 feet o.c.

3.4 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.5 GATE OPERATOR INSTALLATION

A. General: Install gate operators according to manufacturer's written instructions, aligned and true to fence line and grade.

B. Excavation for Pedestals: Hand-excavate holes for bases in firm, undisturbed soil to dimensions and depths and at locations as required by gate operator component manufacturer's written instructions and as indicated.

C. Concrete Bases: Cast-in-place or precast concrete, depth not less than 12 inches, dimensioned and reinforced according to gate operator component manufacturer's written instructions and as indicated on Drawings.

D. Vehicle Loop Detector System: Cut grooves in pavement and bury and seal wire loop according to manufacturer's written instructions. Connect to equipment operated by detector.

E. Comply with NFPA 70 and manufacturer's written instructions for grounding of electric-powered motors, controls, and other devices.

3.6 GROUNDING AND BONDING

A. Comply with Section 26 05 26 "Grounding and Bonding for Electrical Systems."

3.7 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Automatic Gate Operators: Energize circuits to electrical equipment and devices. Adjust operators, controls, safety devices, and limit switches.

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. Lubricate hardware, gate operators, and other moving parts.

3.8 DEMONSTRATION

A. Train Owner's personnel to adjust, operate, and maintain gates.

END OF SECTION 32 31 19

SECTION 32 31 13 - CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Chain-link fences.
2. Swing gates.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:

a. Fence and gate posts, rails, and fittings.
b. Chain-link fabric, reinforcements, and attachments.
c. Gates and hardware.

B. Shop Drawings: For each type of fence and gate assembly.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include accessories, hardware, gate operation, and operational clearances.

C. Samples for Initial Selection: For each type of factory-applied finish.

D. Samples for Verification: For each type of component with factory-applied finish, prepared on Samples of size indicated below:

1. Polymer-Coated Components: In 6-inch lengths for components and on full-sized units for accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For factory-authorized service representative.

B. Product Certificates: For each type of chain-link fence, and gate.

C. Product Test Reports: For framework strength according to ASTM F1043, for tests performed by a qualified testing agency.

D. Field quality-control reports.

E. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

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

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing fence grounding; member company of NETA or an NRTL.

B. Mockups: Build mockups to set quality standards for fabrication and installation.

1. Build mockup for typical chain-link fence and gate, including accessories.

a. Size: 10-foot length of fence.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure to comply with performance requirements.
b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
c. Faulty operation of gate operators and controls.

2. Warranty Period: 15 years from date of Material Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design chain-link fence and gate frameworks.

B. Structural Performance: Chain-link fence and gate frameworks shall withstand the design wind loads and stresses for fence height(s) and under exposure conditions indicated according to ASCE/SEI 7.

1. Design Wind Load: As indicated on Drawings.

a. Minimum Post Size: Determine according to ASTM F1043 for post spacing not to exceed 10 feet for Material Group IA, ASTM F1043, Schedule 40 steel pipe.

2.2 CHAIN-LINK FENCE FABRIC

A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist according to "CLFMI Product Manual" and requirements indicated below:

1. Fabric Height: As indicated on Drawings.
2. Steel Wire for Fabric: Wire diameter of 0.120 inch.

a. Mesh Size: 2 inches.
b. Polymer-Coated Fabric: ASTM F668, Class 1 over aluminum -coated steel wire.

1) Color: As selected by Design Professional from manufacturer's full range, according to ASTM F934.

3. Selvage: Knuckled at both selvages.

2.3 FENCE FRAMEWORK

A. Posts and Rails: ASTM F1043 for framework, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F1043 based on the following:

1. Fence Height: As indicated on Drawings.
2. Horizontal Framework Members: top and bottom rails according to ASTM F1043.

a. Top Rail: 1.66 inches in diameter.

3. Brace Rails: ASTM F1043.

4. Metallic Coating for Steel Framework:

   a. Type A: Not less than minimum 2.0-oz./sq. ft. average zinc coating according to ASTM A123/A123M or 4.0-oz./sq. ft. zinc coating according to ASTM A653/A653M.
   b. Type B: Zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film.
   c. External, Type B: Zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film. Internal, Type D, consisting of 81 percent, not less than 0.3-mil- thick, zinc-pigmented coating.
   d. Type C: Zn-5-Al-MM alloy, consisting of not less than 1.8-oz./sq. ft. coating.
   e. Coatings: Any coating above.

5. Polymer coating over metallic coating.

   a. Color: As selected by Design Professional from manufacturer's full range, according to ASTM F934.

2.4 TENSION WIRE

A. Polymer-Coated Steel Wire: 0.177-inch- diameter, tension wire according to ASTM F1664, Class 1 over aluminum -coated steel wire.

   1. Color: As selected by Design Professional from manufacturer's full range, according to ASTM F934.

B. Aluminum Wire: 0.192-inch- diameter tension wire, mill finished, according to ASTM B211, Alloy 6061-T94 with 50,000-psi minimum tensile strength.

2.5 SWING GATES

A. General: ASTM F900 for gate posts and double swing gate types.

   1. Gate Leaf Width: As indicated on Drawingfs.
   2. Framework Member Sizes and Strength: Based on gate fabric height as indicated.

B. Pipe and Tubing:

   1. Zinc-Coated Steel: ASTM F1043 and ASTM F1083; protective coating and finish to match fence framework.
   2. Gate Posts: Round tubular steel.
   3. Gate Frames and Bracing: Round tubular steel.

C. Frame Corner Construction: assembled with corner fittings.

D. Hardware:

1. Hinges: 180-degree inward swing.
2. Latch: Permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.
3. Lock: Manufacturer's standard internal device.

2.6 FITTINGS

A. Provide fittings according to ASTM F626.

B. Post Caps: Provide for each post.

1. Provide line post caps with loop to receive tension wire or top rail.

C. Rail and Brace Ends: For each gate, corner, pull, and end post.

D. Rail Fittings: Provide the following:

1. Top Rail Sleeves: Pressed-steel or round-steel tubing not less than 6 inches long.
2. Rail Clamps: Line and corner boulevard clamps for connecting and rails to posts.

E. Tension and Brace Bands: [**Pressed steel**] [**Aluminum Alloy 6063**].

F. Tension Bars: Steel, length not less than 2 inches shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.

G. Truss Rod Assemblies: [**Steel, hot-dip galvanized after threading**] [**Mill-finished aluminum**] rod and turnbuckle or other means of adjustment.

H. Tie Wires, Clips, and Fasteners: According to ASTM F626.

1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, according to the following:

a. Hot-Dip Galvanized Steel: 0.106-inch- diameter wire.

I. Finish:

1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz./sq. ft. of zinc.

a. Polymer coating over metallic coating.

2.7 GROUT AND ANCHORING CEMENT

A. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure

without needing protection by a sealer or waterproof coating, and that is recommended in writing by manufacturer for exterior applications.

2.8 GROUNDING MATERIALS

A. Connectors and Grounding Rods: Listed and labeled for complying with UL 467.

1. Connectors for Below-Grade Use: Exothermic welded type.
2. Grounding Rods: Copper-clad steel, 5/8 by 96 inches.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.

1. Do not begin installation before final grading is completed unless otherwise permitted by Architect.

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

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 CHAIN-LINK FENCE INSTALLATION

A. Install chain-link fencing according to ASTM F567 and more stringent requirements specified.

1. Install fencing on established boundary lines inside property line.

B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.

C. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.

1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.

a. Concealed Concrete: Place top of concrete [**2 inches**] <**Insert dimension**> below grade [**as indicated on Drawings**]to allow covering with surface material.

b. Posts Set into Sleeves in Concrete: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with [**nonshrink, nonmetallic grout**] [**or**] [**anchoring cement**], mixed and placed according to anchoring material manufacturer's written instructions. Finish anchorage joint to slope away from post to drain water.

c. Posts Set into Holes in Concrete: Form or core drill holes not less than 5 inches deep and 3/4 inch larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with [**nonshrink, nonmetallic grout**] [**or**] [**anchoring cement**], mixed and placed according to anchoring material manufacturer's written instructions. Finish anchorage joint to slope away from post to drain water.

3. Mechanically Driven Posts: Drive into soil to depth of [**30 inches**] [**36 inches**] <**Insert dimension**>. Protect post top to prevent distortion.

D. Terminal Posts: Install terminal end, corner, and gate posts according to ASTM F567 and terminal pull posts at changes in horizontal or vertical alignment of [**15 degrees or more**] [**30 degrees or more**] [**as indicated on Drawings**] <**Insert requirement**>. For runs exceeding 500 feet, space pull posts an equal distance between corner or end posts.

E. Line Posts: Space line posts uniformly at [**96 inches**] [**10 feet**] <**Insert dimension**> o.c.

F. Post Bracing and Intermediate Rails: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.

1. Locate horizontal braces at midheight of fabric 72 inches or higher, on fences with top rail, and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.

G. Tension Wire: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch- diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c. Install tension wire in locations indicated before stretching fabric. Provide horizontal tension wire at the following locations:

1. Extended along [**top**] [**and**] [**bottom**] of fence fabric. Install top tension wire through post cap loops. Install bottom tension wire within 6 inches of bottom of fabric and tie to each post with not less than same diameter and type of wire.
2. Extended along top of [**barbed wire arms**] [**extended posts**] and top of fence fabric to support barbed tape.
3. [**As indicated on Drawings**] <**Insert requirements**>.

H. Top Rail: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.

I. Intermediate and Bottom Rails: Secure to posts with fittings.

J. Chain-Link Fabric: Apply fabric to [**outside**] [**inside**] of enclosing framework. Leave [**1-inch**] [**2-inch**] bottom clearance between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.

K. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts, with tension bands spaced not more than 15 inches o.c.

L. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric according to ASTM F626. Bend ends of wire to minimize hazard to individuals and clothing.

1. Maximum Spacing: Tie fabric to line posts at 12 inches o.c. and to braces at 24 inches o.c.

M. Fasteners: Install nuts for tension bands and carriage bolts on the side of fence opposite the fabric side.[**Peen ends of bolts or score threads to prevent removal of nuts.**]

N. Privacy Slats: Install slats in direction indicated, securely locked in place.

1. [**Vertically**] [**Horizontally**][**, for privacy factor of 70 to 75**] <**Insert privacy factor range**>.
2. Diagonally[**for privacy factor of 80 to 85**] <**Insert privacy factor range**>.
3. Direction[**and privacy factor**] as indicated on Drawings.

O. Barbed Wire: Install barbed wire uniformly spaced[**, angled toward security side of fence**] [**as indicated on Drawings**]. Pull wire taut, install securely to extension arms, and secure to end post or terminal arms.

P. Barbed Tape: Install according to ASTM F1911. Install barbed tape uniformly in configurations indicated and fasten securely to prevent movement or displacement.

3.4 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation.

3.5 GATE-OPERATOR INSTALLATION

A. Install gate operators according to manufacturer's written instructions, aligned and true to fence line and grade.

B. Excavation: Hand-excavate holes for posts, pedestals, and equipment bases/pads, in firm, undisturbed soil to dimensions and depths and at locations according to gate-operator component manufacturer's written instructions and as indicated.

C. Vehicle Loop Detector System: [**Cut grooves in pavement, bury, and seal**] [**Bury**] wire loop according to manufacturer's written instructions. Connect to equipment operated by detector.

D. Ground electric-powered motors, controls, and other devices according to NFPA 70 and manufacturer's written instructions.

3.6 GROUNDING AND BONDING

A. Comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

B. Fence and Gate Grounding:

1. Ground for fence and fence posts shall be a separate system from ground for gate and gate posts.
2. Install ground rods and connections at maximum intervals of [**1500 feet**] <**Insert dimension**>.
3. Fences within 100 Feet of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of [**750 feet**] <**Insert dimension**>.
4. Ground fence on each side of gates and other fence openings.

    a. Bond metal gates to gate posts.
    b. Bond across openings, with and without gates, except openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches below finished grade.

C. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a ground rod located a maximum distance of 150 feet on each side of crossing.

D. Fences Enclosing Electrical Power Distribution Equipment: Ground according to IEEE C2 unless otherwise indicated.

E. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.

1. Make grounding connections to each barbed wire strand with wire-to-wire connectors designed for this purpose.
2. Make grounding connections to each barbed tape coil with connectors designed for this purpose.

F. Connections:

1. Make connections with clean, bare metal at points of contact.
2. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
3. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
4. Make above-grade ground connections with mechanical fasteners.

5. Make below-grade ground connections with exothermic welds.
6. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

G. Bonding to Lightning Protection System: Ground fence and bond fence grounding conductor to lightning protection down conductor or lightning protection grounding conductor according to NFPA 780.

H. Comply with requirements in Section 26 41 13 "Lightning Protection for Structures."

3.7 FIELD QUALITY CONTROL

A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests.

B. Grounding Tests: Comply with requirements in Section 26 41 13 "Lightning Protection for Structures."

C. Prepare test reports.

3.8 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Automatic Gate Operator: Energize circuits to electrical equipment and devices, start units, and verify proper motor rotation and unit operation.

1. Hydraulic Operator: Purge operating system, adjust pressure and fluid levels, and check for leaks.
2. Test and adjust operators, controls[**, alarms,**] and safety devices. Replace damaged and malfunctioning controls and equipment.
3. Lubricate operator and related components.

C. Lubricate hardware and other moving parts.

3.9 DEMONSTRATION

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

END OF SECTION 32 31 13

SECTION 32 84 00 - IRRIGATION SYSTEMS (PERFORMANCE SPECIFICATION)

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. The work to be done shall include furnishing all plans, all labor, materials, equipment and services (includes valves, piping, sprinklers, specialties, accessories, control, and wiring for sodded sport field two wire irrigation system(s). Work performed shall be as indicated on the drawings, as specified herein; or both.

B. The point of connection for the irrigation system shall be as shown on the the Utility Plans as stubs. Backflow prevention and meter shall be provided and shall be considered a part of the irrigation system.

C. The Drawings and Specifications must be interpreted and are intended to complement each other. The Contractor shall furnish and install all parts, which may be required by the Drawings and omitted by the specifications, or vice versa. Should there be appear to be discrepancies or question of intent, the Contractor shall refer the matter to the Owner's Representative for decision, and his interpretation shall be final, conclusive and binding.

D. All necessary changes to the drawings to avoid any obstacles shall be made by the Contractor with the approval of the Owner's Representative.

E. Trench excavation, back filling, reseeding and remulching, together with the testing of the completed installation shall be included in this work.

F. Record drawings shall also be included in this work.

Section Includes:

1. Piping.
2. Manual valves.
3. Pressure-reducing valves.
4. Automatic control valves.
5. Automatic drain valves.
6. Transition fittings.
7. Miscellaneous piping specialties.
8. Controllers.
9. Boxes for automatic control valves.

1.3 DEFINITIONS

A. Circuit Piping: Downstream from control valves to sprinklers, specialties, and drain valves. Piping is under pressure during flow.

B. Drain Piping: Downstream from circuit-piping drain valves. Piping is not under pressure.

C. Main Piping: Downstream from point of connection to water distribution piping to, and including, control valves. Piping is under water-distribution-system pressure.

D. 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.

1.4 PROJECT DESIGN PARAMETERS

A. Irrigation system layout shall be diagrammatic. Exact locations of piping, sprinkler heads, valves, and other components shall be established by Contractor and the Irrigation Designer in the field at time of installation. Design irrigation design to provide a 60 psi at base of sprinkler head.

B. Baseball / Little League (Youth Baseball) Field

1. Contractor will stake mainline and all heads and valves and receive approval from irrigation designer prior to excavation. Contractor is ultimately responsible for maintaining 100% coverage on entire irrigated site.
2. Utilize “Block” style system for irrigation system layout.
3. Full circle heads and part circle heads shall be zoned separately.
4. Infield area to be zoned separately. Sprinkler head spacing shall not exceed fifty feet (50’) triangular spaced.
5. Infield foul area to be zoned separately. Sprinkler head spacing shall not exceed thirty feet (30’) triangular spaced.
6. Space sprinkler components as indicated by detail. Sprinkler head spacing shall not exceed fifty feet (50’) triangular spaced.
7. Sprinkler row spacing shall not exceed fifty feet (50’). Minimum 5 row spacing.
8. Provide 100% complete coverage within inside of fenced playing area. Adjust sprinkler locations as necessary to prevent over-watering of skinned infield area and warning track.
9. Install all valves outside of fenced playing area.
10. Provide two (2) isolation valves on mainline installed in 10” valve boxes.
11. Provide one (1) quick coupler behind pitcher’s mound installed in 10” valve box.
12. Provide two (2) quick couplers installed in 10” valve box. Locate behind first and third base in the foul area at the fence

C. Soccer/Football Field (inside track), Competition Field, K-8 Field

1. Contractor will stake mainline and all heads and valves and receive approval from irrigation designer prior to excavation. Contractor is ultimately responsible for maintaining 100% coverage on entire irrigated site.
2. Utilize “Block” style system for irrigation system layout.
3. Full circle heads and part circle heads shall be zoned separately.
4. Space sprinkler components as indicated by detail. Sprinkler head spacing shall not exceed fifty feet (50’) squared spaced.
5. Sprinkler row spacing shall not exceed fifty feet (50’). Minimum 4 row spacing. Adjust row spacing to avoid goal area.
6. Provide 100% complete coverage within boundaries of surrounding track. Adjust sprinkler locations as necessary to avoid over-watering onto high jump area and track.
7. Install all valves outside of playing field.
8. Provide two (2) isolation valves on mainline installed in 10” valve boxes.
9. Provide two (1) quick coupler at mid-point of field on irrigation main.

D. Softball Field

1. Contractor will stake mainline and all heads and valves and receive approval from irrigation designer prior to excavation. Contractor is ultimately responsible for maintaining 100% coverage on entire irrigated site.
2. Utilize “Block” style system for irrigation system layout.
3. Full circle heads and part circle heads shall be zoned separately.
4. Infield skinned area shall not be irrigated.
5. Space sprinkler components as indicated by detail. Sprinkler head spacing shall not exceed fifty feet (50’) triangular spaced.
6. Sprinkler row spacing shall not exceed fifty feet (50’). Minimum 5 row spacing.
7. Provide 100% complete coverage within inside of fenced playing area. Adjust sprinkler locations as necessary to prevent over-watering of skinned infield area and warning track.
8. Install all valves outside of fenced playing area.
9. Provide two (2) isolation valves on mainline installed in 10” valve boxes.
10. Provide two (2) quick couplers installed in 10” valve box. Locate behind first and third base in the foul area at the fence.

E. Minor adjustments in system layout will be permitted to clear existing fixed obstructions. Final system layout shall be acceptable to the Irrigation Designer.

F. Cutting and patching:

1. Cut through concrete and masonry with core drills. Jack hammers not permitted.
2. Materials and finishes for patching shall match existing cut surface materials and finish.

Exercise special care to provide patching at openings and exterior walls. Subject to approval of General Contractor's Representative.

3. Methods and materials used for cutting and patching shall be acceptable to the Irrigation Designer.

1.5 PERFORMANCE REQUIREMENTS

A. Irrigation zone control shall be automatic operation with controller and automatic control valves.

B. Delegated Design: Design 100 percent sports field irrigation system(s), including comprehensive design analysis by a certified irrigation designer, using performance requirements and design criteria indicated.

1. Water Source: On-site, public water system, as shown on civil drawings. System shall include all necessary connections, controls and appurtenances.
2. Pressure Source: Design shall include pump(s) as necessary to provide pressure and flow necessary for full operation irrigation system.
3. Irrigation Area: All areas of soccer/football and baseball field as indicated on the landscape drawings. System shall be designed to apply irrigation to each individual field within the irrigation area.
4. Irrigation Rate: System shall be designed to apply approximately 1-in depth of irrigation per week over entire irrigation area under a normal operating schedule.

C. Minimum Working Pressures: The following are minimum pressure requirements for piping, valves, and specialties unless otherwise indicated:

1. Irrigation Main Piping: 200 psig (1380 kPa).
2. Circuit Piping: 150 psig (1035 kPa).

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Wiring Diagrams: For power, signal, pump (if required), and control wiring.

C. Delegated-Design Submittal: For irrigation systems, an Irrigation Plan, to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified, certified irrigation designer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Irrigation systems, drawn to scale, on which components are shown and coordinated with each other, using input from Installers of the items involved. Also include adjustments necessary to avoid plantings and obstructions such as signs and light standards.

B. Qualification Data: For qualified Installer.

C. Zoning Chart: Show each irrigation zone and its control valve.

D. Controller Timing Schedule: Indicate timing settings for each automatic controller zone.

E. Field quality-control reports.

1.8 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sprinklers controllers, automatic control valves and pumps to include in operation and maintenance manuals.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers that include a certified irrigation designer qualified by The Irrigation Association, a Professional Class member of the American Society of Irrigation Consultants or a Professional Technical Class member of the American Society of Irrigation Consultants.

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.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver piping 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.

B. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Comply with requirements in the piping schedule for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes per the irrigation system design.

B. PE Pipe with Controlled ID: ASTM F 771, PE 3408 compound; SIDR 11.5 and SIDR 15.

1. Insert Fittings for PE Pipe: ASTM D 2609, nylon or propylene plastic with barbed ends. Include bands or other fasteners.

C. PE Pipe with Controlled OD: ASTM F 771, PE 3408 compound, SDR 11.

1. PE Butt, Heat-Fusion Fittings: ASTM D 3261.
2. PE Socket-Type Fittings: ASTM D 2683.

D. PE Pressure Pipe: AWWA C906, with DR of 7.3, 9, or 9.3 and PE compound number required to give pressure rating not less than 200 psig (1380 kPa).

1. PE Butt, Heat-Fusion Fittings: ASTM D 3261.
2. PE Socket-Type Fittings: ASTM D 2683.

E. PVC Pipe: ASTM D 1785, PVC 1120 compound, Schedules 40 and 80.

1. PVC Socket Fittings: ASTM D 2466, Schedules 40 and 80.
2. PVC Threaded Fittings: ASTM D 2464, Schedule 80.
3. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket ends.

F. PVC Pipe, Pressure Rated: ASTM D 2241, PVC 1120 compound, SDR 21.

1. PVC Socket Fittings: ASTM D 2467, Schedule 80.
2. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket or threaded ends.

2.2 PIPING JOINING MATERIALS

A. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

B. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.3 MANUAL VALVES

A. Bronze Ball Valves:

1. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded or solder joint if indicated.
g. Seats: PTFE or TFE.
h. Stem: Bronze.
i. Ball: Chrome-plated brass.
j. Port: Full [or regular, but not reduced].

B. Plastic Ball Valves:

1. Description:

a. Standard: MSS SP-122.
b. Pressure Rating: 125 psig (860 kPa) minimum.
c. Body Material: PVC.
d. Type: Union.
e. End Connections: Socket or threaded.
f. Port: Full.

C. Bronze Gate Valves:

1. Description:

a. Standard: MSS SP-80, Type 2.
b. Class: 125.
c. CWP Rating: 200 psig (1380 kPa).
d. Body Material: ASTM B 62 bronze with integral seat and screw-in bonnet.
e. Ends: Threaded or solder joint.
f. Stem: Bronze, nonrising.
g. Disc: Solid wedge; bronze.
h. Packing: Asbestos free.
i. Handwheel: Malleable iron, bronze, or aluminum.

2.4 PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Description:

a. Standard: ASSE 1003.
b. Body Material: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).
c. Pressure Rating: Initial pressure of 150 psig (1035 kPa).
d. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).

2.5 AUTOMATIC CONTROL VALVES

A. Bronze, Automatic Control Valves:

1. Description: Cast-bronze body, normally closed, diaphragm type with manual-flow adjustment, and operated by 24-V ac solenoid.

2.6 AUTOMATIC DRAIN VALVES

A. Description: Spring-loaded-ball type of corrosion-resistant construction and designed to open for drainage if line pressure drops below 2-1/2 to 3 psig (17 to 20 kPa).

2.7 TRANSITION FITTINGS

A. General Requirements: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

B. Transition Couplings:

1. Description: AWWA C219, metal sleeve-type coupling for underground pressure piping.

C. Plastic-to-Metal Transition Fittings:

1. Description: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-socket or threaded end.

D. Plastic-to-Metal Transition Unions:

1. Description: MSS SP-107, PVC four-part union. Include one brass or stainless-steel threaded end, one solvent-cement-joint or threaded plastic end, rubber O-ring, and union nut.

2.8 CONTROLLERS

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. Hunter Industries Incorporated.
2. Nelson, L. R. Corporation.
3. Rain Bird Corporation.
4. Toro Company (The); Irrigation Division.

B. Description:

1. Controller Stations for Automatic Control Valves: Include switch for manual or automatic operation of each station.
2. Exterior Control Enclosures: NEMA 250, Type 4, weatherproof, with locking cover and two matching keys; include provision for grounding.
    a. Body Material: Stainless-steel sheet metal.
    b. Mounting: Freestanding type for concrete base.
3. Control Transformer: 24-V secondary, with primary fuse.
4. Timing Device: Adjustable, 24-hour, 14-day clock, with automatic operations to skip operation any day in timer period, to operate every other day, or to operate two or more times daily.
    a. Manual or Semiautomatic Operation: Allows this mode without disturbing preset automatic operation.
    b. Nickel-Cadmium Battery and Trickle Charger: Automatically powers timing device during power outages.
    c. Surge Protection: Metal-oxide-varistor type on each station and primary power.
5. Pump Control: Automatic control of irrigation pump.
6. Location: As determined by owner.
7. Moisture Sensor: Adjustable from one to seven days, to shut off water flow during rain.
8. Wiring: UL 493, Type UF multiconductor, with solid-copper conductors; insulated cable; suitable for direct burial.
    a. Feeder-Circuit Cables: No. 12 AWG minimum, between building and controllers.

b. Low-Voltage, Branch-Circuit Cables: No. 14 AWG minimum, between controllers and automatic control valves; color-coded different from feeder-circuit-cable jacket color; with jackets of different colors for multiple-cable installation in same trench.
c. Splicing Materials: Manufacturer's packaged kit consisting of insulating, spring-type connector or crimped joint and epoxy resin moisture seal; suitable for direct burial.

9. Concrete Base: Reinforced precast concrete not less than 36 by 24 by 4 inches (900 by 600 by 100 mm) thick, and 6 inches (150 mm) greater in each direction than overall dimensions of controller. Include opening for wiring.

2.9 BOXES FOR AUTOMATIC CONTROL VALVES

A. Plastic Boxes:

1. Description: Box and cover, with open bottom and openings for piping; designed for installing flush with grade.

a. Size: As required for valves and service.
b. Sidewall Material: PE, ABS, or FRP.
c. Cover Material: PE, ABS, or FRP.

1) Lettering: "IRRIGATION."

B. Drainage Backfill: Cleaned gravel or crushed stone, graded from 3/4 inch (19 mm) minimum to 3 inches (75 mm) maximum.

2.10 SPRINKLERS

Large Rotary Turf - 1" threaded inlet, stainless steel riser with the ability to mount ½" below grade.

Large Rotary Turf - 3/4" threaded inlet, stainless riser. Sprinklers shall be gear-driven with integral check valve.

1. 4 to 5” pop-up to clear tall grasses
2. Top arc indication for adjustments from 90° to 360°
3. Smart Arc memory returns sprinkler to previously set arc if vandalized
4. Continuous unidirectional rotation provided uniform coverage when set at 360°
5. Standard rubber cover for safety
6. Check valve to prevent low-head drainage and keep laterals charged with water
7. Three-year warranty.
8. Interchangeable nozzles.

Small Rotary Turf - 1/2" threaded inlet, plastic riser. Sprinklers shall be gear-driven with integral check valve.

1. 4 to 5” pop-up to clear tall grasses
2. Top arc indication for adjustments from 90° to 360°

3. Smart Arc memory returns sprinkler to previously set arc if vandalized
4. Standard rubber cover for safety
5. Check valve to prevent low-head drainage and keep laterals charged with water
6. Three-year warranty
7. Interchangeable nozzles.

2.11 BOOSTER PUMP (if necessary)

A. General: System design shall include pump(s) as necessary to convey water from on-site water supply, to the irrigation system at pressures and flow rates required by the irrigation system demand.

1. Enclosure: Pump(s) shall be housed in above ground heated enclosures appropriately sized and vented. Heater shall be thermostatically controlled. Provide appropriately sized concrete pad under pump and enclosure.
2. Controls: Pump(s) shall have automatic controls.
3. Operating Efficiency: Pumps shall operate at 55% or greater efficiency during normal system operating conditions.
4. Coordinate pump location with owner.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

B. Install warning tape directly above pressure piping, 12 inches (300 mm) below finished grades, except 6 inches (150 mm) below subgrade under pavement and slabs.

C. Drain Pockets: Excavate to sizes required by system design. Backfill with cleaned gravel or crushed stone, graded from 3/4 to 3 inches (19 to 75 mm), to 12 inches (300 mm) below grade. Cover gravel or crushed stone with sheet of asphalt-saturated felt and backfill remainder with excavated material.

D. Provide minimum cover over top of underground piping according to the following:

1. Irrigation Main Piping: Minimum depth of not less than 18 inches (450 mm) below average local frost depth.
2. Circuit Piping: 12 inches (300 mm).
3. Drain Piping: 12 inches (300 mm).
4. Sleeves: 24 inches (600 mm).

3.2 PREPARATION

A. Set stakes to identify locations of proposed irrigation system. Obtain Architect's approval before excavation.

3.3 PIPING INSTALLATION

A. Location and Arrangement: Drawings indicate location and arrangement of piping systems. Install piping as indicated unless deviations are approved on Coordination Drawings.

B. Install piping at minimum uniform slope of 0.5 percent down toward drain valves.

C. Install piping free of sags and bends.

D. Install groups of pipes parallel to each other, spaced to permit valve servicing.

E. Install fittings for changes in direction and branch connections.

F. Install unions adjacent to valves and to final connections to other components with NPS 2 (DN 50) or smaller pipe connection.

G. Install flanges adjacent to valves and to final connections to other components with NPS 2-1/2 (DN 65) or larger pipe connection.

H. Install expansion loops in control-valve boxes for plastic piping.

I. Lay piping on solid subbase, uniformly sloped without humps or depressions.

J. Install PVC piping in dry weather when temperature is above 40 deg F (5 deg C). Allow joints to cure at least 24 hours at temperatures above 40 deg F (5 deg C) before testing.

K. Install piping in sleeves under parking lots, roadways, and sidewalks.

L. Install sleeves made of Schedule 80 PVC pipe and socket fittings, and solvent-cemented joints.

3.4 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. Threaded Joints: Thread pipe with tapered pipe threads according to 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.

D. PE Piping Fastener Joints: Join with insert fittings and bands or fasteners according to piping manufacturer's written instructions.

E. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End PE Pipe and Fittings: Use butt fusion.
2. Plain-End PE Pipe and Socket Fittings: Use socket fusion.

F. PVC Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Pressure Piping: Join schedule number, ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
3. PVC Nonpressure Piping: Join according to ASTM D 2855.

3.5 VALVE INSTALLATION

A. Pressure-Reducing Valves: Install in boxes for automatic control valves or aboveground between shutoff valves.

B. Throttling Valves: Install in underground piping in boxes for automatic control valves.

C. Drain Valves: Install in underground piping in boxes for automatic control valves.

3.6 AUTOMATIC IRRIGATION-CONTROL SYSTEM INSTALLATION

A. Equipment Mounting: Install exterior freestanding controllers on precast concrete bases.

1. Place and secure anchorage devices. Use 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.

B. Install control cable in same trench as irrigation piping and at least 2 inches (51 mm) below or beside piping. Provide conductors of size not smaller than recommended by controller manufacturer. Install cable in separate sleeve under paved areas.

3.7 CONNECTIONS

A. Install piping adjacent to equipment, valves, and devices to allow service and maintenance.

B. Connect wiring between controllers and automatic control valves.

3.8 IDENTIFICATION

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on each automatic controller.

1. Text: In addition to identifying unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

3.9 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

C. 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, operate controllers and automatic control valves to confirm proper system operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Any irrigation product will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.10 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that controllers are installed and connected according to the Contract Documents.
3. Verify that electrical wiring installation complies with manufacturer's submittal.

3.11 ADJUSTING

A. Adjust settings of controllers.

B. Adjust automatic control valves to provide flow rate at rated operating pressure required for each sprinkler circuit.

C. Adjust devices, except those intended to be mounted aboveground, so they will be flush with, or not more than 1/2 inch (13 mm) above, finish grade.

3.12 CLEANING

A. Flush dirt and debris from piping before installing sprinklers and other devices.

3.13 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain automatic control valves and controllers.

3.14 PIPING SCHEDULE

A. Install components having pressure rating equal to or greater than system operating pressure.

B. Piping in control-valve boxes and aboveground may be joined with flanges or unions instead of joints indicated.

C. Aboveground irrigation main piping, NPS 4 (DN 100) and smaller, shall be one of the following:

1. Galvanized-steel pipe and galvanized-steel pipe nipples; galvanized, gray-iron threaded fittings; and threaded joints.
2. Schedule 40 or Schedule 80, PVC pipe; socket-type PVC fittings; and solvent-cemented joints.
3. Schedule 80, PVC pipe; Schedule 80, threaded PVC fittings; and threaded joints.

D. Underground irrigation main piping, NPS 4 (DN 100) and smaller, shall be one of the following:
1. Schedule 40 or Schedule 80, PVC pipe and socket fittings, and solvent-cemented joints.
2. Schedule 80, PVC pipe; Schedule 80, threaded PVC fittings; and threaded joints.
3. SDR 21, PVC, pressure-rated pipe; Schedule 80, PVC socket fittings; and solvent-cemented joints.

E. Circuit piping, NPS 2 (DN 50) and smaller, shall be one of the following:

1. SIDR 9 PE, controlled ID pipe; insert fittings for PE pipe; and fastener joints.
2. DR 9, PE, controlled OD pipe; PE butt, heat-fusion, or PE socket-type fittings; and heat-fusion joints.
3. Schedule 40, PVC pipe and socket fittings; and solvent-cemented joints.
4. SDR 26, PVC, pressure-rated pipe; Schedule 40, PVC socket fittings; and solvent-cemented joints.

F. Circuit piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100), shall be one of the following:

1. SIDR 9, PE, controlled ID pipe; insert fittings for PE pipe; and banded or fastener joints.
2. DR 9, PE, controlled OD pipe; PE socket or butt-fusion fittings; and heat-fusion joints.
3. Schedule 40, PVC pipe and socket fittings; and solvent-cemented joints.
4. SDR 26, PVC, pressure-rated pipe; Schedule 40, PVC socket fittings; and solvent-cemented joints.

G. Underground Branches and Offsets at Sprinklers and Devices: Schedule 80, PVC pipe; threaded PVC fittings; and threaded joints.

1. Option: Plastic swing-joint assemblies, with offsets for flexible joints, manufactured for this application.

H. Drain piping shall be one of the following:

1. SIDR 9, 11.5, or 15, PE, controlled ID pipe; insert fittings for PE pipe; and banded or fastener joints.
2. Schedule 40, PVC pipe and socket fittings; and solvent-cemented joints.
3. SDR 21, 26, or 32.5, PVC, pressure-rated pipe; Schedule 40, PVC socket fittings; and solvent-cemented joints.

3.15 VALVE SCHEDULE

A. Shutoff-Duty Valves:

1. NPS 2 (DN 50) and Smaller: Bronze or ball valve.
2. NPS 2 (DN 50) and Smaller: Bronze gate valve.

B. Throttling-Duty Valves:

1. NPS 2 (DN 50) and Smaller: Bronze automatic control valve.
2. NPS 2 (DN 50) and Smaller: Bronze ball valve.
3. NPS 2-1/2 and NPS 3 (DN 65 and DN 80): [Bronze] [Plastic] automatic control valve.

C. Drain Valves:
1. NPS 1/2 and NPS 3/4 (DN 15 and DN 20): Plastic ball valve.
2. NPS 1 to NPS 2 (DN 25 to DN 50): Plastic ball valve.

END OF SECTION 32 84 00

SECTION 32 84 23 – AUTOMATIC SPORTS FIELD IRRIGATION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. The work of this Section consists of providing and installing an underground irrigation system main lines as shown and specified. The work includes:

1. Automatic irrigation system main including piping, valves, fittings, thrust blocks, and accessories to be installed.

2. Control wire and sleeving.

3. Testing.

4. Excavating and backfilling irrigation work.

5. Install tracer wire along with all non-metallic piping for tracking purposes.

1.3 REFERENCE STANDARDS

A. Materials, equipment, and methods of installation shall comply with the following codes and standards:

1. All local and State codes.
2. National Fire Protection Association, (NFPA): National Electrical code.
3. American Society for Testing and Materials, (ASTM).
4. National Sanitation Foundation, (NSF).
5. The Irrigation Association, (IA).

B. Installer's qualifications: minimum of five (5) years' experience installing irrigation systems of comparable size. The irrigation system contractor shall have an installation crew consisting of a minimum of three (3) persons who each have a minimum of three years' experience installing irrigation systems.

1. The contractor shall be able to demonstrate his ability to perform emergency or warranty repair work within a minimum of 24 hours' notice from the city. The contractor shall have a dedicated service department independent from his installation crews.

2. The contractor must provide a list of the last 3 projects completed within the last 2 years that are of similar size and complexity. Name, address and phone numbers shall be included.

1.4 SUBMITTALS

A. Submittals shall he made in accordance with Section 013300 "Submittal Procedures."

B. Submit manufacturer's product data and installation instructions for each of the system components including but not limited to Included but not limited to the following; irrigation system heads, manual, remote control and quick coupling valves, valve boxes, fittings, wire, wire connectors, pipe and appurtenances, etc.

C. Upon irrigation system acceptance, submit five (5) copies of written operating and maintenance instructions, including winterization procedure. Provide format and contents as directed by the Engineer.

D. Record Drawings:

1. The Contractor shall provide and keep up to date a complete set of "AS Built" record set of prints which shall be corrected as the work progresses, and show every change from the original drawings and specifications and the actual "As Built" dimensions and kinds of equipment. This set of drawings shall be kept on site and shall be used only as a record set.

2. These drawings shall also serve as progress sheets, and the Contractor shall make neat and legible annotations thereon as the work proceeds, showing the work as actually installed. These drawings shall be available at all times for inspection and shall be kept in the Contractor's mobile office on location at all times for inspection.

3. Record drawings shall show the location of all sprinklers, valve boxes, valve markers, controllers, pipe, wire trenches, multiple wire splice boxes, sensors and all pertinent material buried and not visible to the eye. Record drawings shall indicate dimensions from two permanent points of easily identifiable nature, if possible, such as sprinkler heads, permanent markers, concrete pads, corner of buildings, large caliper trees, etc.

a. Contractor shall submit to the Owner a laminated half-size copy of the as-built irrigation plan suitable for mounting.

4. The contractor shall GPS the record drawings and shall submit the electronic file and record drawings for final approval.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver irrigation system components in manufacturer's original undamaged and unopened containers with labels intact and legible.

B. Deliver plastic piping in bundles, packaged to provide adequate protection of pipe ends.

C. Store and handle materials to prevent damage and deterioration.

D. Provide secure, locked storage for valves, and similar components that can not be immediately replaced, to prevent installation delays.

1.6 PROJECT CONDITIONS

A. Known underground and surface utility lines are indicated on other drawings. Unknown utilities may exist. It is the contractor's responsibility to have all utilities located before the commencement of construction activity.

B. Protect existing trees, plants, lawns, and other features designated to remain as part of the final landscape work.

C. Promptly repair damage to adjacent facilities caused by irrigation system work operations. The cost of repairs shall be at the Contractor's expense.

D. Minor adjustments in system layout may be necessary to clear existing and proposed fixed obstructions. Final system layout shall be acceptable to the Landscape Architect.

E. Cutting and Patching:

1. Cut through concrete and masonry for conduits with core drills. Jack hammers are not permitted.

2. Materials and finishes for patching shall match existing cut surface materials and finish. Exercise special care to provide patching at openings in exterior walls wate tight.

3. Methods and materials used for cutting and patching shall be acceptable to the Landscape Architect.

1.7 WARRANTY

A. For a period of one (1) year from the date of final acceptance of the irrigation system, the contractor shall promptly furnish and install any parts which prove defective due to faulty product or faulty installation by the contractor.

B. During the warranty period, the contractor shall extend to the Owner, any and all warranties that apply to equipment found to be defective in either materials or workmanship, as extended by the manufacturer and/or distributor to the contractor. The limits of this equipment warranty shall be expressly stated by the appropriate manufacturer/distributor in writing.

1.8 COORDINATION

A. Coordinate work of this Section with that of other trades, under this and other Contracts with the Owner, affecting or affected by this work, and cooperate with the other trades as is necessary to assure the steady progress of work.

B. Before proceeding with installation work, inspect all project conditions and all work of other trades to assure that all such conditions and work are suitable to satisfactorily receive the work of this Section and notify the Landscape Architect in writing of any which are not. Do not proceed further until corrective work has been completed or waived.

C. Do not interrupt existing services without Owner's approval. Schedule interruptions in advance, according to Owner's instructions. Interruptions shall be scheduled at such times of day and work so that they have minimal impact on Owner's operations.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Sprinkler Manufacturers: As specified or approved equal

B. Manufacturers' products shall conform to the specifications and shall be deemed acceptable by the Landscape Architect.

C. Approval: Wherever the terms "approval," "approved" or "or equal" are used in the specifications, they shall be the approval of the Owner in writing. No substitution of material from those specified on the plans and in the specifications shall be permitted without the written approval of the Owner. Any request for substitutions of specified materials must be submitted in writing by the Contractor to the Owner no less than 5 business days prior to the bid date. The Owner will notify the Contractor of approved substitutions in writing. The alternate product submittal shall include catalog cut sheets, performance specifications and written notification indicating purpose of the submittal.

2.2 MATERIALS

A. General: Contractor/bidder shall submit and install a single manufacturer for the following components;

1. Irrigation sprinkler heads, automatic controller system (controller, remote control valves, radio system, flow sensors, rain sensors)

2. Provide only new materials, without flaws or defects and of the highest quality of their specified class and kind.

3. Comply with pipe sizes indicated. No substitution of smaller pipes will be permitted. Larger sizes may be used subject to acceptance of the Landscape Architect.

4. Provide pipe continuously and permanently marked with manufacturer's name or trademark, size schedule and type of pipe, working pressure at 73 degrees F. and National Sanitation Foundation (NSF) approval

B. Pipe, Fittings, and Connections

1. Polyvinyl chloride pipe: ASTM D2241, Type 1, Grade 1 rigid, unplasticized PVC, extruded from virgin parent material, conforming to CS256-63. Provide pipe homogeneous throughout and free from visible cracks, holes, foreign materials, blisters, wrinkles, and dents.

a. All piping for sleeves under roadways, sidewalks, etc., shall be PVC, Schedule 80, unless otherwise stated on the plans.

b. All main line piping shall be polyvinyl chloride pipe and shall be SDR 21, Class 200, integrated bell and spigot type rubber gasket joint.

c. All lateral pipe shall be polyvinyl chloride pipe and shall be SDR 21, Class 200, solvent weld bell end.

2. Fittings:

a. Fittings for PVC main line piping shall be ductile iron gasket fittings. The ductile iron fittings shall have deep bell push on joints with gaskets meeting ASTM F-477. These fittings shall be for change of direction and or tapped service tees. These fittings shall be manufactured by Harco Manufacturing or approved equal.

b. Fittings for PVC lateral piping shall be schedule 40 PVC fittings, suitable for solvent weld and threaded connections.

C. Nipples:

1. Plastic: Factory-threaded Schedule 80, Type 1, Grade 1 polyvinyl chloride (PVC) pipe, threaded both ends. Pipe shall be in conformance with ASTM D1784 and D1785, gray color.

2. Metallic: Schedule 40 red brass (35% copper, 15% zinc) pipe, threaded both ends. Pipe shall be in accordance with ASTM B43. Fittings shall be of U.S. manufacture.

D. Solvents and Sealants:

1. Solvent Cement: Compatible with PVC pipe and of proper consistency conforming to ASTM D2564.

2. Threaded connections: All threaded pipe, fittings, and valve connections excepting the sprinkler body inlet, shall use thread sealant.

E. Triple Swing Joints

1. General:

a. Shall be molded of rigid polyvinyl chloride (PVC), Schedule 80, pressure rated at 315 psi. Type 1, Cell classification 12454-B per ASTM specification D 1784, with NPT threads and pipe sockets per ASTM D 2464 and D2466, respectively. Each rotating joint shall be sealed with an EPDM rubber 0-ring, installed pre-compressed in a sealing groove free of parting lines to prevent leakage. Modified stub ACME threads shall have special engineered (S.E.) diameters and clearances to allow full circle (360º) movement and to reduce stress concentrations and joint fracture at thread roots.

b. Factory Assembled.

2. Products: For Irrigation Head

a. Lasco Unitized Triple Swing

1) G-172-212 for Hunter I-25 sprinklers
2) T712-212 for Hunter I-20 sprinklers
3) T512-208 for Multi stream rotor sprinklers

b. Spears

c. Dura Plastic Products

d. Approved equal

3. Products: For Quick Coupler

a. Lasco Unitized Triple Swing

1) G-172S-218
2) 1 inch unitized with brass nipple

b. Spears

c. Dura Plastic Products

d. Approved equal

F. Valves and Associated Equipment:

1. Manual Gate Valves:

a. Manual gate valve shall be installed where indicated on the plans. Non-Rising Stem: Valves shall be Class 125 and 200 psi CWP, non-rising stem, screw-in bonnet, solid wedge and USA manufactured in accordance with MSS-SP 80. Body, bonnet, external stuffing box and

wedge are to be of bronze ASTM B-62. Stems shall be of dezincification-resistant silicon bronze ASTM B-371 or low-zinc alloy B-99, non-asbestos packing and malleable or ductile iron hand wheel. For buried service - Bronze Cross is required. Valve ends shall be threaded-type. Valves shall be of U.S. manufacture.

2. Electric Valve

a. The valve shall be a normally closed, electronically-actuated, diaphragm-operated, remote-control valve.

b. The valve shall be available in a globe configuration with 1, 1-1/2 or 2-inch Female National Pipe Thread (FNPT) inlet and outlet. The valve shall be equipped with a flow control mechanism with removable handle that will regulate flow from full on to completely off.

c. The body and bonnet shall be constructed of solid brass rated to 220 PSI (15 bars, 1500 kPa). The bonnet bolts shall be serviceable with a slotted screwdriver, Phillips screwdriver, or a hex wrench, and shall be held captive in the bonnet when the bonnet is removed from the valve body. The diaphragm assembly shall be of molded construction, reinforced with nylon fabric and have a thermoplastic elastomer seating material. The valve shall be equipped with an internal filter as well as a self-cleaning metering rod, so only clean water can enter the solenoid chamber. A filter cleaning system that cleans a stainless steel filter each time the valve opens and closes, shall be standard. All metal parts internal to the valve shall be manufactured from corrosion-resistant stainless steel.

d. The valve shall have an adjustable pressure regulating device with a calibrated dial for setting of the outlet pressure. (The regulator shall be capable of adjusting the outlet pressure from between 20 and 100 PSI (1.4 to 7.0 bars; 138 to 689 kPa) when inlet pressure is 15 PSI (1.0 bars; 103 kPa) or greater than regulated outlet pressure.) The regulated downstream pressure shall remain constant regardless of variations in upstream pressure. The regulation shall be maintained when valve is manually operated with use of internal bleed valve. The regulator should be capable of regulating upstream pressures from 35 psi to 220 psi.

e. The standard solenoid shall be a 24 VAC unit with a 350mA inrush current and 190mA holding current at 60 cycles. The solenoid shall be an encapsulated, one-piece unit with captive plunger. It shall be equipped with manual internal bleed capability to release the upper chamber water to the downstream piping, allowing the valve to open.

f. The valve shall be manufactured, qualified and released in the USA. The valve, model number IBV series, shall be manufactured by The Hunter Industries.

3. Gate Valves:

a. Non-rising Stem Gate Valves 3 inches and larger: AWWA C500, cast-iron double disc, bronze disc and seat rings or AWWA C509, resilient seated stem, cast-iron body and bonnet, stem nut, 200 pig working pressure, and ends that fit NPS dimension, PVC pipe. Include elastomeric gaskets.

b. American Made

4. Quick Coupler Valve

a. General
   1) One inch with Acme thread
   2) Vinyl Cap Cover
   3) American Made

b. Products
   1) Hunter HQ-44LRC-AW
   2) Approved equal

G. Thrust Blocks: Use 3,000 PSI concrete and 2-mil plastic to wrap fittings and pipe.

H. Valve Access Boxes:

1. Valve access boxes shall be tapered enclosures of rigid plastic material comprised of fibrous components, chemically inert and unaffected by moisture corrosion and temperature changes. Provide lid of same material, green in color.

2. Valve access boxes for electric valve assemblies shall be 18" deep with 10" X 15” rectangular cover.

3. Valve boxes shall be of sufficient size to still allow room for maintenance without having to excavate or perform similar operations conforming to ASTM D368 for tensile strength of 18 inch deep and furnished with a non-hinged cover.

4. Valve boxes for quick coupling valves shall be 10” diameter valve boxes.

5. Products

a. Carson
b. Ametek
c. Brooks Industries
d. Approved equal

J. Irrigation Rotors

1. General: All heads shall be as specified on the drawings or approved equal. Nozzle patterns are indicated and shown; however, specific site conditions may require that different nozzle patterns be used. Contractor shall adjust patterns to provide adequate coverage for misting or cooling of field area. All heads shown on the drawings shall be installed and have the following minimum characteristics:

2. Rotary Sprinklers:

   a. Rotary gear driven.

   b. Stainless Steel riser.

   c. Sprinklers with a radius over 45’ shall have available twelve (12) nozzles discharging from 5.1 to 26.9 GPM at 70 psi. Sprinklers with a radius of 45’ or less shall have available eight (8) nozzles discharging from 1.5 to 8.0 GPM at 45 psi.

   d. The nozzles shall have the primary and secondary orifices together in an integral unit and shall be color-coded to identify nozzle size.

   e. The sprinkler shall have radius adjustment capabilities by means of a stainless steel nozzle retainer/radius adjustment screw

   f. The sprinkler shall be equipped with a drain check valve to prevent low head drainage, and be capable of checking up to 10 feet in elevation change.

   g. The sprinkler shall be serviceable after installation by unscrewing the body cap, removing the riser assembly, and extracting the inlet filter screen.

3. Multi-Stream Rotary Sprinklers:

   a. Multi-stream, multi-trajectory rotary nozzle with a viscous drive for rotation.

   b. Nozzles have female threads for installation on male-threaded pop-up sprinklers.

   c. Each nozzle shall have a filter screen to prevent internal system debris from entering the nozzle and the patented double-pop feature to prevent external debris from falling into the nozzle. Each nozzle shall be color-coded for easy field identification.

   d. Sprinkler body shall be pop-up type with pressure-regulation, with 4” pop-up height. Pressure shall be regulated to 40 psi. Sprinkler shall have a factory drain check valve. Pressure-regulated models shall have

FloGuard™ technology to reduce the flow through the riser in the event of a missing nozzle.

4. Products:

a. Hunter Model # I-25-04-SS

b. Hunter Model # I-20-04-SS.

c. Hunter Model #MP Rotator nozzles with Model #PROS-04-PRS40-CV

K. Automatic Control System

a. The controller shall be of a modular design with a standard 6-station model. There shall be 6-station modules that enable the controller to be customized from 6 stations up to 42 stations. The removable station modules shall allow servicing of, and removing of the module(s) without removing field wires from the controller.

b. The controller shall have four independent programs (A, B, C, and D) with 8 start times per program for programs A, B, and C; and 16 start times for program D for a total of up to 40 daily start times. Any two programs shall have the capability of running concurrently. Watering times shall be available from 1 minute to 12 hours in 1-minute increments per station. There shall be a programmable delay between stations available of up to 9 hours. The controller shall have 4 weekly schedule options to choose from: 7-day calendar, 31-day calendar, odd day programming and even day programming. It shall also have a 365-day calendar clock to accommodate true odd-even watering. Operation shall be available in automatic, semi-automatic and manual modes. All programming shall be accomplished by use of a programming dial and selection buttons with user feedback provided by a backlit LCD display. The front panel of the controller shall be removable and capable of being programmed when not attached to the controller cabinet.

c. The controller shall be equipped with a rain sensor on-off switch that allows the user to override a sensor that has suspended watering. The controller shall have a programmable rain delay that turns off the controller for a predetermined period of time, from 1 to 180 days.

d. The controller shall have a cycle and soak scheduling capability by station that allows a cycle to be programmed for up to 60 minutes and a soak period to be programmed for up to 120 minutes.

e. The controller shall have a seasonal adjustment feature with 3 different modes that allows station run times to be altered from 0% to 300% by program to compensate for weather changes. The modes shall include a Global Adjust, Monthly Adjust, and a Solar Sync Adjust. The Global Adjust shall increase the station run times in a given program by a fixed percentage. The Monthly Adjust shall allow all the seasonal adjustment

values for the full year to be programmed into the controller, for each program. The Solar Sync Adjust shall allow the seasonal adjustment values to occur on a daily basis when a Hunter Solar sync is connected to the controller.

f. The controller shall be capable of monitoring up to two Clik-type sensors or flow sensors in the plastic configuration, and up to 3 Clik-type sensors or flow sensors in the metal configuration.

g. The controller shall permit connection of a flow meter which is calibrated by the operator for the pipe diameter in which it is installed. The flow meter shall measure actual flow in gallons or liters. The controller shall have a learning mode in which the controller operates each single station for a short period, learns the actual flow for each station, and stores the information internally by station.

h. When the learned flow is exceeded during normal operations the controller shall record a flow alarm event, cease irrigating the station or stations contributing to the high or low flow readings, and resume irrigation with any stations which do not cause alarms. The controller shall have the ability to determine high or low flow conditions when multiple stations are operating, and shall perform diagnostics to identify stations which contribute to the problem flow. Allowable limits and duration of incorrect flow shall be preset, but reprogrammable by the operator for unique local conditions. The flow meter shall be a Hunter Industries HFS in an appropriately sized FCT fitting. It shall also be possible to except certain stations from flow monitoring devices. The controller shall also be equipped with a flow-totalizing function that will provide a running total of all the gallons or liters of water used between two reference dates.

i. Automatic programs shall have user-programmed Non-Water windows to except certain time windows from watering, regardless of the water day schedule.

j. Automatic programs shall also permit the designation of non-water days, even when Odd/Even or Interval Day patterns have been set. Non-water window violations shall be detected and the operator shall be alerted when an irrigation program would have run during a non-water window.

k. The controller shall have a Quick Check test program, permitting all stations to run sequentially for a user-entered period of time, programmable in one-second increments up to 10 minutes each, for system startup and diagnostics.

l. The controller shall also save an Easy Retrieve Program which stores all original programming settings. The installing contractor shall be able to restore the system to this saved state at any time after initial installation. The stored Easy Retrieve settings may also be updated at any time by the operator.

m. The controller shall have a one-button manual station advance in Test mode for quick diagnostics checks.

n. The controller shall be equipped with a programmable pump start/master valve circuit that can activate the pump start relay by zone. It shall also have a programmable delay between valve stations. Delays between stations shall be programmable up to a maximum of 10 hours.

o. Transformer input shall be 120/240 VAC, 50/60Hz. Transformer output shall be 24 VAC, 1.5A (40VA). All AC power wiring connections shall be made in an internal junction box. Maximum output per station shall be 24 VAC, 0.56A. Program backup shall be provided by a non-volatile memory circuit that will hold the program information indefinitely. The controller shall have Metal Oxide Varistors (MOVs) on the AC power input portion and the secondary output portion to help protect the micro-circuitry from power surges. The secondary MOVs shall be enclosed in the station modules for easy servicing. There shall be self-diagnostic, electronic short circuit protection that detects a faulty circuit, continues watering the remainder of the program, and reports the faulty station on the display. The diagnostic procedure shall also be capable of being initiated by the user manually. The controller shall provide backup timekeeping in the event of a power outage with the use of an internal long-life lithium battery.

p. The controller shall have a diagnostic feature that provides a visual indication via LED lights that show the current status of sensor activity, station activity and flow activity. Any station or flow alarms shall be report on the LCD display.

q. The controller shall have stainless steel wall-mounted cabinet,

r. The controller shall have as an option, the ROAM or ICR remote control package that enables remote operation of the controller. Connection of remotes to the controller shall be provided through factory-installed SmartPort® outlet.

s. The controller shall have a multi-language capability that allows programming of the display in 6 different languages: English, French, Spanish, German, Italian, and Portuguese. It shall also be capable of setting the units of measure to either English (GPM) or Metric (LPM)

t. The controller shall be installed in accordance with the manufacturer's published instructions. The controller shall carry a conditional five year exchange warranty. The automatic controller(s) shall be the I-CORE series controller as manufactured for Hunter Industries Incorporated, San Marcos, California.

L. Rain Switch

1. Solar Sync:

a. The Solar Sync shall automatically adjust run times for controller stations based on a local evapo-transpiration sensor, connected to a compatible automatic irrigation controller via SmartPort interface.

b. The Solar Sync shall include only local evapo-transpiration data, “local data” being defined as sensed climatological conditions within the immediate coverage area of the irrigation system, from a sensor dedicated to that purpose. The Solar Sync shall not require broadcast, subscription, or other generalized weather data, and shall function as a standalone ET-based irrigation system when directly connected to a compatible automatic irrigation controller of up to 48 stations.

c. The Solar Sync shall consist of two physical components, including a Solar Sync Sensor mounted in an optimum location for measurement of climatological data, and a module, containing database information which shall be connected to the irrigation controller’s SmartPort.

d. The Solar Sync Sensor shall be mounted within 200 ft./60m of the irrigation controller. The Solar Sync Sensor shall include individual sensors for solar radiation, and air temperature, and shall also include a rain sensor. The rain sensor shall be capable of interrupting the power from the irrigation controller to the valves when rainfall exceeds a pre-selected amount.

e. The rain sensor circuitry shall utilize 2 sets of hygroscopic disks to activate switches in the unit. One switch will be for the total rainfall compensation unit and the other for the Quick Response□ unit. The Quick Response□ unit will turn off the irrigation system within 5 minutes of the onset of precipitation, depending on the intensity.

f. The sensor shall be adjustable by turning a plastic collar on the device that regulates an opening, thus varying the rate of evaporation from the disks.

g. In addition, the built-in temperature sensor shall be capable of interrupting the power from the irrigation controller to the valves when ambient air temperature falls below 37 degrees Fahrenheit (3 degrees Centigrade).

h. All sensors shall be integrated into a single array, and shall be housed in an UV and corrosion resistant plastic casing.

i. The sensor shall have an integral, adjustable, aluminum, mounting bracket that allows installation on angled, as well as perpendicular surfaces. The sensor shall have a mounting option that allows for installation on a rain gutter.

j. The Solar Sync shall permit the user to designate a no water window that prevents any irrigation from occurring during a specific period of the day.

k. The Solar Sync shall be fully functional with 24VAC input or less, with a max current draw of 25ma, and shall not require a dedicated high-voltage transformer or connection. The Solar Sync system shall be CE [C-tick] approved.

l. The Solar Sync shall be installed in accordance with the manufacturer's published instructions. The Solar Sync shall be manufactured for Hunter Industries Incorporated, San Marcos, California.

M. Grounding

1. The controller shall be grounded to 10 OHMS or less to insure proper surge and lightning protection.

2. Grounding system shall include U.L. listed 5/8" x '10 copper clad ground rod; 4"x 96" grounding plate with '25 of #4 bare copper wire and 100 pounds of grounding enhancing material and Cadweld GT1161G igniter.

N. Control Wire:

1. Electrical control and common wire from the controller to the electric valves shall be type UF, 600 volt, PE coated direct burial single strand solid copper wire, sized at 14 gauge for zone wire and 12 gauge for the common wire Provide one color wire for each of the following:

a. Zone control valves
b. Common wire
c. Spare wire

2. Power wire shall be sized 10/2-grd. The power wire shall be multi conductor with ground UL approved, type UF for direct bury. The wire shall be by Paige Electric Corporation or approved equal.

3. All wire within building enclosures shall be installed in electrical conduit. Conduit shall be of steel construction. Grounding wire shall have a separate conduit out to grounding grid.

4. Wire connectors for 24 volt control wiring shall be as manufactured by 3M, Model No. DBY/R-6.

5. Utility Warning Tape: 5 mil, 2" (min.) detectable warning tape. Color code for utility marking tape – irrigation blue with white stripe

O. Accessories:

1. Drainage fill shall be 1/2" to 3/4" crushed stone.

a. Fill shall be clean soil free of stones larger than 2" diameter, foreign matter, organic material and debris.

b. Provide imported fill material as required to complete the work. Obtain rights and pay all costs for imported materials.

c. Suitable excavated materials removed to accommodate the irrigation system work may be used as fill material subject to the Engineer's review and acceptance.

2.3 PUMPING SYSTEM

A. It is the intention of this specification to describe a self-enclosed automatic pump station for a turf irrigation system. This shall be accomplished by using a completely prefabricated pump station conforming to the following specifications. Supply shall be flooded, city water booster. The water supply type shall be identified in the accompanying Technical Specifications and shall call out the suction lift or incoming pressure in feet of head, (TDH).

B. The pumping station shall be WaterMax Model Number WMBV-5000-7-5-460-3-100-35 as manufactured by WATERTRONICS, INC. 525 Industrial Drive, P.O. Box 530, Hartland, Wisconsin 53029-0530, www.watertronics.com.

1. The pump station performance at enclosure limits shall be as noted in the technical specifications. The capacity, discharge pressure, maximum water lift or pump inlet pressure if a booster system and intake line dimensions shall be per the technical specifications. The pump shall operate at no more than 3600 RPM. The power supply to the station shall be as noted in the technical specifications.

2. The station shall be completely wired, piped, dynamically flow and pressure tested prior to shipment.

3. Operational sequence: The pump shall activate automatically upon detecting a drop in pressure in the irrigation main line if it is a flooded or suction lift application and by recognizing flow if it is a city water booster application or a remote start signal. Operation shall be maintained at an adjustable minimum demand. The pump shall be automatically retired when the demand falls below the minimum adjustable set point for an adjustable time delay.

4. Construction: Construction shall be of modular form utilizing a base structurally adequate to support pumps, piping, and electrical equipment as a single integral assembly. All nuts, bolts washers, and fasteners shall be stainless steel, zinc or cadmium plated for corrosion resistance.

C. Pump and Motor

1. Pump shall be electric motor driven, horizontal centrifugal with mechanical shaft seal, volute case and impeller. The shaft seal shall be a self-adjusting mechanical type to prevent leakage and eliminate the need for a drain piping. The volute case shall be precision machined from gray cast iron and engineered to modern hydraulic standards. It shall be possible to rotate the discharge connection to any of four positions. A heavy cast iron bracket shall maintain alignment between the motor and volute case. The impeller shall be an enclosed type and balanced to provide smooth operation. The impeller shall be keyed to the shaft and locked with a special cap screw and washer. The motor shaft is to be manufactured from high grade steel and of reduced length to increase shaft rigidity, extend bearing life, and reduce the overall length of the pump and motor assembly. The pump shaft shall be protected with a replaceable stainless steel sleeve. The pump, motor and impeller shall be removable from the back of volute case for service without disturbing the plumbing.

2. Pump motor shall be a squirrel cage induction horizontal solid shaft type. The pump impeller shall be direct mounted and keyed to the motor shaft with a stainless steel protective sleeve. The temperature rise of the motor shall be to NEMA Standard for class B or Class F insulation. Radial and thrust bearings of ample capacity to accommodate the hydraulic thrust of the pump shall be incorporated into the motor.

D. Piping Manifold, Valves, Gauges and Other Mechanical Equipment

1. All fabricated piping shall conform to ASTM specifications A53 for Grade B welded or seamless schedule 40 pipe. All welded flanges shall be forged steel, slip-on or weld neck type. All welded fittings shall be seamless, ASTM Specification A234, with pressure rating not less than 150 PSI.

2. A fabricated full flow bypass shall be constructed of ASTM specification A53 Grade B welded or seamless schedule 40 pipe. All welded flanges shall be forged steel, slip-on or weld neck type. All welded fitting shall be seamless, ASTM Specification A234, with pressure rating not less than 150 PSI. Full flow bypass shall be complete with 3 butterfly isolation valves to allow for complete isolation and bypass of the pump. All valves shall be installed inside the enclosure for vandal resistance.

3. On flooded suction booster stations, the pump check valve shall be cast iron bodied with a spring-loaded single disc. Check valves shall be sized according to the maximum discharge flow of the pump. Pressure drop across the check valve shall not exceed 2.5 PSI at full flow. On suction lift stations the check valve will be removed and a pressure rated foot valve will be supplied to attach on the end of the suction pipe.

4. Pump shall be isolated by means of a butterfly valve after the check valve and before the piping exits the station enclosure. Isolation valves shall be butterfly type with ten position lever, rated for 200 PSI WOG working pressure. Trim

shall include stainless steel stem, bronze or nickel coated iron streamlined disk with full faced resilient seat design to eliminate need for flange gaskets.

5. Drains shall be provided from all low points in the system and shall consist of 1/4" petcocks or ball valves.

6. Pressure gauges shall be located upstream and downstream of the pump for easy reading of the intake and discharge pressure. Pressure gauges shall be 304 stainless steel case and bezel construction. Gauges shall be 2-1/2" diameter, liquid filled. Pressure sensing connection shall be 1/4" NPT lower gauge connection.

7. A three-pole, service rated main station disconnect shall be mounted in a separate NEMA 4 enclosure outside the pump station enclosure to completely isolate the pump station electrical system from incoming power.

8. The temperature of the pump shall be sensed by a thermal switch. The thermal switch shall be located on the pump volute. Externally mounted snap disc type thermal switches will not be accepted. The thermal switch shall activate upon a temperature rise above 120 degrees Fahrenheit.

9. The pump station discharge manifold shall incorporate an insertion type, pulse frequency output flow sensor for continuous output to pump station controls. The flow sensor output pulse shall be conditioned and fed directly to the processor for conversion and display in Gallons Per Minute and totalize. Flow sensor accuracy shall be no less than 2% for flow velocities ranging from 1 - 30 feet per second.

10. A solid state pressure transducer shall provide a noise free, linear output proportional to discharge pressure. Transducer shall be solid state, strain gauge type with integral voltage regulating and output accuracy not less than 0.5%. Transducer shall be constructed of stainless steel and rated for the maximum pump station discharge pressure.

E. Variable Frequency Drive (VFD)

1. The variable frequency drive shall be IGBT based with selectable carrier frequency up to 15 KHZ. The VFD shall include terminals for incoming power, motor output power and control terminals. The VFD shall generate a sine-coded, variable voltage/frequency, three-phase output for optimum speed control. The VFD shall incorporate power loss ride-through. VFD protective features shall include current limit, short circuit protection, electronic motor overload protection and ground fault protection. The VFD shall have push button programming display for easy access to operation parameters. VFD must be designed for operation in 50 degree C temperature condition.

2. Electrical controls shall conform to National Electrical Code Standards.

F. Control Alarms:

1. Low System Pressure Safety Shutdown

a. When the station discharge pressure remains below an adjustable set point for the time called out in the Technical Specifications, the pumps will be de-energized and remain so until the alarm is manually reset. The Low Pressure alarm will be indicated on the processor display.

2. High System Pressure Safety Shutdown

a. When the station discharge pressure remains above an adjustable set point for the time called out in the Technical Specifications, the pumps will be de-energized and remain so until the alarm is manually reset. The High Pressure alarm will be indicated on the processor display.

3. High Pump Volute Temperature Shutdown

a. If the pump volute case temperature rises above 120 degrees F. for the pre-programmed time, the pump will be de-energized and remain so until the alarm is manually reset. The High Temperature alarm will be indicated on the processor display.

4. Motor Overload Shutdown

a. If the over current condition lasts longer than the pre-programmed limit the motor will be de-energized and remain so until the alarm is manually reset. The overload alarm will be indicated on the processor display.

5. Phase Loss

a. The controls will sense a phase loss on the incoming power supply. If the phase loss is for longer than the drive ride through time, the motor will be de-energized and remain so until the alarm is manually reset. The Phase Loss alarm will be indicated on the processor display.

6. VFD Fault Shutdown

a. The VFD shall sense additional internal faults that will cause the VFD to shut down for system protection. These faults will be indicated on the processor display.

7. Lightning Arrestor

a. The main power supply to the pump station shall be equipped with a secondary lighting arrestor having a breakdown current rating of not less than 60,000 Amps at 14,000 Volts discharge. Power supplies 300 Volts and less shall use a 300 Volt arrestor with an 800 Volt spark-over Voltage. Power supplies up to 600 Volts shall use a 600 Volt rated arrestor with a 1,000 Volt spark-over Voltage.

8. Corrosion Inhibiting Modules

   a. Corrosion inhibiting modules shall be installed in the main electrical control enclosure in accordance with the manufacture's recommendations.

G. Mounting Base and Enclosure

1. Construction shall include a fabricated base assembly to support all components during shipping and to serve as the installed mounting base. Pump station base shall be formed from a single sheet of 1/4" plate resulting in a seamless, one piece base with rounded edges and corners. Height is to be 3-1/2" inches. The base shall be strategically reinforced beneath as required to provide additional support and strength. The base shall be drilled and tapped allowing the pump to be secured to the base. The base shall be shot blasted to bare metal prior to painting process.

2. Construction shall include a weather resistant, 14 gauge or equivalent, all metal enclosure. The front side of the enclosure shall have oversized cooling vents. The enclosure is to be supplied with a two internally mounted gas struts that shall extend to keep the access door open. All components are to be accessible from top and front sides with the door completely open. Enclosure is to be suitable for mounting to the pump station base and shall include openings for suction and discharge piping.

H. Exhaust Fan

1. For the purpose of cooling the pump motor, switchgear and control logic, an exhaust fan shall be located inside the pump enclosure, mounted to the enclosure lid. The exhaust fan shall be activated upon pump start and shall run until the pump stops. The fan shall be black die-cast aluminum construction with UL94V-0 rated polycarbonate propeller and rated for not less than 240 CFM. Fan motor shall be permanent split capacitor type with stainless steel ball bearings, class B insulation and automatic thermal protection.

I. Painting

1. Painting of the entire pump station shall consist of a multi-step coating system which includes metal preparation, rust inhibitive baked epoxy prime coat, and a two part ultraviolet light insensitive baked polyurethane finish having total dry film thickness of not less than 5 mils. Prime coat and finish coat shall be baked at 165 degrees for not less than 30 minutes to achieve a high gloss, corrosion resistant finish. Exterior pump station components shall be painted medium green. Electrical control enclosure shall be appliance white.

J. Drop Pipes

1. The inlet and discharge piping system will be attached to dual 90 degree drop pipes to provide below grade connection to a suction pipe or city water supply

pipe or below grade connection to a discharge main line. Drop pipe sizes, connection fitting style and depth of bury will be shown on the project drawings.

K. Full Flow Bypass

1. A full flow bypass piping system shall be provided. Pump bypass piping will have three isolation butterfly valves to allow city water pressure and flow to be directed around the pump. This allows isolation of the pump and motor for service without disrupting the irrigation system supply.

L. Pump Enclosure Heater

1. The pump station enclosure will include a thermostatically controlled 500 watt heater. The heater will include its own fan for air movement. The heater will have circuit protection.

M. Testing

1. The pump station and all its component parts shall undergo a complete hydraulic and electrical test prior to shipment from the factory. Testing shall be dynamic and include operation over the entire flow range of the pump station under specified suction and net discharge pressure conditions. A plot containing actual flow, pressure, KW consumption and motor RPM shall be furnished as part of the owner's manual.

N. Owner's Manual

1. Complete start up instructions shall be provided by the manufacturer in the form of an owner's manual.

2. The manufacturer shall warrant the pump station to be free of defects for one year from date of start up or fifteen months after shipment, whichever occurs first. Failures caused by lightning strikes, power surges, vandalism, operator abuse, or acts of God are excluded from warranty coverage.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine final grades and installation conditions. Do not start irrigation system work until unsatisfactory conditions are corrected.

3.2 PREPARATION

A. Layout and stake the location of each pipe run and all valves. Obtain Landscape Architect's acceptance of layout prior to excavating.

B. All sleeves required for the installation of the irrigation system are to be installed by the general contractor. Wires are to be installed in separate sleeves.

3.3 INSTALLATION

A. Excavation and Backfill:

1. Excavation shall include all materials encountered.

2. Excavate trenches of sufficient depth and width to permit proper handling and installation of pipe and fittings.

3. Excavate to depths required to provide 2" depth of earth fill or sand bedding for piping when rock or other unsuitable bearing material is encountered.

4. Fill to match adjacent grade elevations with approved earth fill material. Backfilling will be done by hand placing soil under, around and above pipe so that it is hand tamped to a point 6" above the pipe. Special care shall be taken to ensure that this layer is completely free of stones and other deleterious material. The remainder of the trench may be machine filled with appropriate available soil. Machine placed backfill shall be compacted to a suitable density by machine tamping and approved rolling to prevent settlement in trench.

   a. If within one (1) year from the date of final acceptance, settlement due to improper compaction occurs and an adjustment in pipes, valves and sprinkler heads, turf or paving is necessary to bring the system, turf or paving to the proper level of the permanent grades, the Contractor, as part of the work under this contract, shall make said adjustments without extra cost to the Owner.

5. Except as indicated, install irrigation mains with a minimum cover of 24" based on finish grades, unless otherwise noted. Install irrigation laterals with a minimum cover of 18" based on finish grades.

6. Excavate trenches and install piping and fill during the same working day. Do not leave open trenches or partially filled trenches open overnight.

7. Where it is necessary to cross existing sidewalks, pipe shall be installed by boring under the walkways. Proper boring equipment shall be used so that undermining of the walkways does not occur.

8. Pipe shall be installed strictly in accordance with the printed recommendations of the manufacturer, including bedding of pipe in the bottom of trench and securely thrusting of any main line fittings at changes in direction of the pipe.

9. All main line piping shall be located outside the primary playing areas. All valve boxes shall be located no closer than 10 feet outside of the playing surfaces.

10. Where pipe is to be installed through walls, core drill wall of sufficient diameter to install pipe and conduit. Once pipe and conduit are installed, seal opening around pipe with non-shrinking grout. Openings shall be watertight.

11. Existing plant material and turf shall be protected during installation. If excavation is necessary in turf areas, remove and replace sod. Any existing planting material and turf damaged during the installation shall be repaired and or replaced at Contractor's expense.

B. Plastic Pipe:

1. Pipe lines shall be installed of the size shown on the drawings and/or specifications and of the materials and workmanship herein specified.

2. All main line piping outside of buildings to be installed in trenches as per the provisions of Section 1.13.A. Lateral piping will be installed in trenches as above.

3. Pipe shall be installed strictly in accordance with the printed recommendations of the manufacturer, including bedding of pipe in the bottom of trench.

C. Fittings, Valves and Accessories:

1. Install fittings, valves and accessories in accordance with manufacturer's instructions, except as otherwise indicated.

2. All control wiring shall be supplied and installed by the irrigation contractor. All wiring shall be performed in accordance with all applicable codes.

3. Install valve access boxes on a suitable base of gravel to provide a level foundation at proper grade and to provide drainage of the access box. Gravel shall extend from the bottom of the valve to 3" below the bottom of the valve box. Valve boxes to be installed flush with finish grade, with one valve installed in each box only. Valve boxes shall be installed with a minimum 10' (min.) separation. Valve box locations to be located on "As Built" drawing with measurements from two permanent markers to each valve box.

4. Seal all threaded connections with approved joint compound. Teflon tape shall not be used. Do not over tighten threaded connections.

D. Wire:

1. All wiring located outside buildings is to be installed in the piping trenches wherever possible. Approved wire ties shall be utilized approximately every 20' on wire runs installed in main line trenches or wire trenches.

2. All wires to be spliced to requirements of local and minimum regulations, or to the following specification. All splices shall be made by baring a minimum of 3/4" of copper conductor twisted together, connected and sealed with an approved splice kit. Procedures recommended by manufacturer shall be strictly followed. At splice location, slack shall allow the splice to be raised a minimum of 24" for inspection. Any underground splices not located at control valve sites shall be housed in a 10" diameter valve box for access.

3. Wire shall be installed with at least 1% slack and have expansion loops at end of 250' runs. Wire shall not be yanked, stretched, or excessively pulled during installation. Wire shall be laid on a firm, even bed in the trench, which shall support the entire length. The Contractor shall take strict precautions to ensure that wires are not cut, scraped, or nicked during installation. Wire shall be laid above and to one side of the main line pipe, never directly over the pipe. Wherever possible, wire shall be laid on the same side of the trench throughout the entire job. All wiring shall be installed with a minimum depth of cover of 12".

4. All wiring shall be installed in accordance with all local, State and National codes.

E. Sleeves:

1. All sleeves for installation of the irrigation system are to be installed by the general contractor. All wire shall be installed in separate sleeves.

F. Testing:

1. The Contractor shall be responsible for all hydraulic pressure testing of main lines and lateral lines. The testing shall be on a continuous basis commencing when the first section of the installation is complete and available for testing and prior to the installation of the pipe insulation. Final testing of the whole system under full operating conditions to be done following complete installation of all main and lateral piping, valves and sprinklers.

2. Prior to testing of the main line pipe, pipe shall be backfilled. Testing for all main line pipe and interior lateral pipe shall consist of a continuous application of water at a pressure of 100 PSI to the piping for a one hour period without visual evidence of leaks. If a leak is discovered within this period, the Contractor shall immediately repair the break and the system then retested for the period described above in this section. Testing of lateral lines located outside of building shall be done on a zone by zone operating basis with any leaks or breaks repaired when evidenced.

3. Operational Test: Activate each remote control valve in sequence from the controller. The Owner’s representative shall visually observe the operation, coverage and leakage. Replace, adjust, or move heads, couplers or other parts of the system as necessary to correct operational, coverage deficiencies or leakage. Repeat testing until each zone passes all tests.

4. Control System Grounding Test: Test for proper grounding of control system per manufacturer’s recommendations. Test results must meet or exceed manufacturer’s guidelines for acceptance. Replace defective wire, grounding rod or other equipment. Repeat test until the guidelines are met.

G. Adjusting the System:

1. Adjustment of the sprinklers, remote control valves, and automatic equipment will be done by the Contractor upon completion of the installation to provide optimum performance and balance throughout the irrigation system.

H. Service:

1. The contractor shall be responsible for the winterization of the system and the spring activation of the system during the one year warranty period.

3.4 DISPOSAL OF WASTE MATERIAL

A. Transport unsuitable excavated material, including rock, to designated disposal areas. Stockpile or spread as directed. Remove from site and legally dispose of trash and debris.

3.5 ACCEPTANCE

A. Upon acceptance, the Owner will assume operation of the system.

B. Prior to the final acceptance of the irrigation system, the Contractor shall submit to the Owner, three (3) copies of written operating and maintenance instructions. The manuals shall include an index sheet stating the Contractor's name, address, telephone number and person to contact, duration of warranty period and an equipment list providing the manufacturer' name, make and model number, the name and address of local manufacturer's representative, spare parts list in detail, and detailed operating and maintenance instructions for the major equipment. The manual also shall include a detailed description of the winter blowout and spring start-up procedures.

3.6 CLEANING

A. Perform cleaning during installation of the work and upon completion of the work. Remove from site all excess materials, soil, debris, and equipment. Repair damage resulting from irrigation system installation.

END OF SECTION 32 82 45

SECTION 32 90 00 PLANTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Trees.
2. Shrubs.
3. Seeded lawns, sod and “no-mow” areas.
4. Topsoil and soil amendments.
5. Fertilizers and mulches.
6. Stakes and guys.
7. Landscape edging.
8. Maintenance, guarantees and warranties.

B. Related Sections: The following Sections (see civil drawings) contain requirements that relate to this Section:

1. Division 31, Section "Site Clearing" for protection of existing trees and planting, topsoil stripping and stockpiling, and site clearing. See civil drawings for specifications.
2. Division 31, Section "Earth Moving" for excavation, filling, rough grading, and subsurface aggregate drainage and drainage backfill. See civil drawings for specifications.
3. Division 31 Section “Erosion Controls” soil erosion and sedimentation control. See civil drawings for specifications.

1.3 INDUSTRY STANDARDS

A. References: Some products and execution are specified in this Section by reference to published specifications or standards of the following:

The American Society for Testing and Materials (ASTM)
American Association of Nurserymen (AAN)
US Department of Agriculture (USDA)
GA Department of Agriculture (GADA)

B. Landscape Contractor shall mean a registered “Landscape Contractor” as defined by the GA General Statutes. Unless proper credentials and evidence of experience can be supplied to prove equal capabilities, only a Landscape Contractor licensed in the State of GA shall be permitted to perform the work.

1. The Landscape Contractor's performance shall conform to the requirements of the Georgia Department of Agriculture the most current standards of the Georgia Green Industry Standards.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.

B. Product certificates signed by manufacturers certifying that their products comply with specified requirements.

1. Manufacturer's certified analysis for standard products.
2. Label data substantiating that plants, trees, shrubs, and planting materials comply with specified requirements.

C. Certification of grass seed from seed vendor for each grass-seed mixture stating the botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

D. Samples of each of the following:

Sample of imported mulch (1) 1-gal. sized bag.
Topsoil (1) 1-gal sized bag.

E. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, at least fifteen names and address of architects and owners, total years of experience and landscape contractor's license number. If the landscape contractor hires a sub-contractor for seeding operations, the same references shall be required from them also.

F. Material test reports from qualified independent testing agency indicating and interpreting test results relative to compliance of the following materials with requirements indicated.

1. Analysis of existing topsoil and suitability as a medium for growing specified lawn. Include recommendations of amendments required to make existing topsoil suitable as a growing medium for specified lawn, if required.
2. Analysis of imported topsoil, if required due to unacceptability of existing topsoil to meet acceptable growing medium requirements for lawn.

G. Planting schedule indicating anticipated dates and locations for each type of planting.

H. Maintenance instructions recommending procedures to be established by Owner for maintenance of landscaping during an entire year. Submit before expiration of required maintenance periods.

I. Landscape plant schedule, per Article 1.4, A, C, indicating quantity, botanical name, common name, specified size and vendor source for each individual plant species; including any substitu-

tions. Include all cultivars and varieties for substitutions. Provide vendor source contact information as attachment to schedule.

CLH Design and the Owner reserve the right to reject any substitution requests and may request that the landscape contractor provide additional vendor search information and/or complete documentation to prove a hardship, to confirm reason(s) for substitution or to prove that the material is not available from local and national nurseries.

Refer to section 1.6, C for information regarding the appropriate time to dig trees. It is the Contractor's responsibility to plan ahead of time rather than waiting and checking availability at the time of installation.

J. All sod shall be from a certified sod producer and be blue tag certified in accordance with GACIA and AOSCA.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed landscaping work similar in material, design, and extent to that indicated for this Project and with a record of successful landscape establishment.

1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on the Project site during times that landscaping is in progress.

B. Testing Agency Qualifications: To qualify for acceptance, an independent testing agency must demonstrate to Architect's satisfaction, based on evaluation of agency-submitted criteria conforming to ASTM E 699, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.

C. Provide quality, size, genus, species, and variety of trees and shrubs indicated, complying with applicable requirements of ANSI Z60.1 "American Standard for Nursery Stock."

1. Contractor shall show proof of cultivar authenticity to Landscape Architect. When cultivars are specified, standard species will not be acceptable.

D. Topsoil Analysis: Furnish a soil analysis made by a qualified independent soil-testing agency stating percentages of organic matter, inorganic matter (silt, clay, and sand), deleterious material, pH, and mineral and plant-nutrient content of topsoil.

1. Report suitability of on-site topsoil for growth of applicable planting material. State recommended quantities of nitrogen, phosphorus, and potash nutrients and any limestone, aluminum sulfate, or other soil amendments to be added to produce a satisfactory topsoil at no additional cost to owner.

E. Measurements: Measure trees and shrubs according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches (150 mm) above ground for trees up to 4-inch (100-mm) caliper size, and 12 inches (300

mm) above ground for larger sizes. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip-to-tip.

When size ranges are given, 50 % of plant material shall be at the larger size.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 01 Section "Project Meetings."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery and while stored at site.

B. Seed: Deliver seed in original sealed, labeled, and undamaged containers.

C. Trees and Shrubs: Deliver freshly dug trees and shrubs. Do not prune before delivery, except as approved by Landscape Architect. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy natural shape. Provide protective covering during delivery. Do not drop trees and shrubs during delivery. For trees which cannot be dug in the summer, Contractor shall have trees pre-dug and heeled-in at the nursery where they are grown until planting. Contractor shall be responsible for ensuring that the trees have been adequately watered and cared for at the nursery prior to delivery. No substitutions will be allowed for trees which cannot be “summer-dug”.

D. Handle balled and burlap stock by the root ball.

E. Deliver trees, shrubs, and ground covers after preparations for planting have been completed and install immediately. If planting is delayed more than 6 hours after delivery, set planting materials in shade, protect from weather and mechanical damage, and keep roots moist.

PLANT MATERIAL SHALL NOT BE DELIVERED TO THE SITE MORE THAN 72 HOURS BEFORE PLANTING TAKES PLACE. THE LANDSCAPE ARCHITECT RESERVES THE RIGHT TO REJECT ALL MATERIAL NOT PLANTED WITHIN THAT TIME PERIOD UNLESS THE LANDSCAPE CONTRACTOR MAKES HEELING-IN AND IRRIGATION PROVISIONS WITHIN 24 HOURS OF PLANT DELIVERY.

1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
2. Do not remove container-grown stock from containers before time of planting.
3. Water root systems of trees and shrubs stored on site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.

1.7 PROJECT CONDITIONS

A. Utilities: Determine location of above grade and underground utilities and perform work in a manner which will avoid damage. Hand excavate, as required. Maintain grade stakes until removal is mutually agreed upon by parties concerned.

B. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Landscape Architect before planting.

1.8 COORDINATION AND SCHEDULING

A. Coordinate installation of planting materials during normal planting seasons for each type of plant material required.

Planting Season: The normal season for planting balled and burlap material is November 15 through March 15. The normal season for planting container grown material is September 15 through April 15. After notification to proceed, planting operations shall be conducted under favorable weather conditions during the normal planting season. The Landscape Contractor shall make provisions for watering the material on an as-needed basis and as frequently as is required to ensure that plant material thrives.

The General Contractor shall coordinate the planting schedule with the Landscape Contractor to avoid any summer digging and planting.

The Landscape Architect shall be notified and must approve of any schedule changes which may require summer planting. THE CONTRACTOR SHALL NOT BE COMPENSATED FOR ADDITIONAL WATERING COSTS FOR PLANTINGS WHICH ARE INSTALLED IN THE SUMMER.

B. Temporary Seeding: In accordance with the schedule as detailed on the drawings.

1. In the event the Landscape Contractor is required to establish a temporary seeding cover due to the construction schedule, the Landscape Contractor is not relieved from providing the specified permanent seed mixture.
2. The Landscape Contractor is responsible for eradicating any temporary seed cover by means of mowing, thatching and using an herbicide approved by the Owner’s representative at the manufacturer’s recommended rate.

1.9 GRASS ESTABLISHMENT SCHEDULE

A. Refer to the Supplementary Conditions for Final Completion dates of grassed areas of the site.

B. Definitions:

1. Final Complete seeded or sprigged grass: A healthy, dense, weed free stand of the specified species of grass with 95% grass coverage as evaluated on a per square yard sample basis. Required topdressing for play fields may be applied following Final completion.
2. Final Complete sodded grass: An installed and rolled healthy sod, free of weeds and dead spots. Required topdressing for play fields may be applied following Final completion.

C. Complete Site: A complete installation of grass sod and/or stand of grass, germinated from seed or sprigs, on the complete site shall be established by the following date:

Complete Site (Seed, Sprig or Sod) Final Completion: *See Final Completion Date noted in contract documents.* Due to seasonal restrictions the specified date shall not be extended. Extension to the Contract Time will not change this date.

1.10 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty: Contractor is responsible for general maintenance and care during warranty period. Contractor agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
Failures include, but are not limited to, the following:

Death and unsatisfactory growth; except for defects resulting from abuse or incidents that are beyond Contractor's control.
Structural failures including plantings falling or blowing over.

Warranty Periods from Date of Final Completion:

Trees, Shrubs and Ornamental Grasses: 12 months.
Lawn, grass and sod (herbicide and fertilizer): 12 months

Include the following remedial actions as a minimum:

Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
A limit of one replacement of each plant will be required except for losses or replacements due to failure to comply with requirements.
Provide extended warranty for period equal to original warranty period, for replaced plant material.

Areas seeded or sodded that are bare and not established at the end of the warranty period shall be re-seeded or re-sodded at no additional cost to the Owner.

Contractor is responsible for applying weed control herbicide and fertilizers during warranty period.

1.11 TREE AND SHRUB MAINTENANCE

A. Maintain trees and shrubs by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, tightening and repairing stakes and guy supports, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray as required to keep trees and shrubs free of insects and disease. The presence of significant insects or disease at the end of warranty period shall be grounds for rejection of material. Restore or replace damaged tree wrappings. Maintain trees and shrubs until end of warranty period.

1.12 LAWN/GRASS MAINTENANCE

A. Begin maintenance of lawns and other grassed areas immediately after each area is planted and continue until acceptable lawn is established and accepted by the Owner, but for not less than the following periods:

1. Seeded Lawns/Grass: **Final Completion**.

When full maintenance period has not elapsed before end of planting/growing season, or if lawn is not fully established at that time (95% coverage as established on a per square yard sample basis), continue maintenance during next planting season until 95% coverage is established.

2. Sodded Lawns/Grass: **Final Completion.**

a. Sodded areas will be accepted at final inspection if –

1. Sodded areas are properly established. Sod is free of bare and dead spots and without weeds. Sodded areas have been mowed a minimum of twice.

B. Maintain and establish lawns by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and re-mulch to produce a uniformly smooth lawn.

C. Watering: Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources and to keep lawns uniformly moist to a depth of 4 inches (100 mm). Following the date of project Final Completion, water from irrigation may be obtained from the site water system.

1. Supplement natural precipitation to provide a net rate of one inch of water per week or as required to maintain lawn in a thriving condition.
2. Watering shall conform to the time, volume and frequency recommendations of applicable governmental water conservation regulations.
3. Irrigate at minimum rate of once per day for two full weeks following date of seeding or sod installation.
4. Irrigate at minimum of once per week for remainder of maintenance period.

D. Mow lawns as soon as there is enough top growth to cut with mower set at specified height for principal species planted. Repeat mowing as required to maintain specified height without cutting more than 40 percent of the grass height at any mowing. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet.

E. Postfertilization: Apply fertilizer to lawn after first mowing and when grass is dry. Apply only from August through October.

1. Use fertilizer that will provide actual nitrogen of at least 1 lb per 1000 sq. ft. (0.5 kg per 100 sq. m) of lawn area or as required to maintain lawn in a thriving condition. A minimum of 50% of the nitrogen shall be in a slow release form.

PART 2 - PRODUCTS

2.1 TREE AND SHRUB MATERIAL

A. General: Furnish nursery-grown trees and shrubs conforming to ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement, including trunks which are not straight on single stem trees.

B. The natural stem/root collar of balled and burlap materials shall be found within two inches of the nursery maintained soil line. Trees shall not be accepted which have been grown too deeply or too high in the soil profile.

C. Grade: Provide trees and shrubs of sizes and grades conforming to ANSI Z60.1 for type of trees and shrubs required. Trees and shrubs of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of roots or balls.

D. Label one tree and shrub in each plant grouping with securely attached, waterproof tag bearing legible designation of botanical and common name. Proof of cultivar shall be required on all species for which a cultivar is designated.

E. Label at least 1 tree and 1 shrub of each variety and caliper with a securely attached, waterproof tag bearing legible designation of botanical and common name.

F. Imported Fire Ant Control: All plants shall be accompanied by a certificate stating: “certified under all applicable state and federal quarantine.” Contact Landscape Architect for inspection of all plant materials for the presence of imported fire ants. The presence of fire ants shall be cause for rejection of plant material.

2.2 SHADE AND FLOWERING TREES

A. Shade Trees: Single-stem trees with straight trunk, free of basal sprouts, well-balanced crown, and intact leader, of height and caliper indicated, conforming to ANSI Z60.1 for type of trees required. Grounds for rejection may include, but not limited to: improper branch density or distribution, “v” crotches, including bark, undesirable multiple leaders, leaders that have been topped or headed back, prevalent suckering or epicormic sprouting. Trees which have evidence of unevenly distributed, girdling or suckering roots may be rejected.

1. Branching Height: 1/2 of tree height.

B. Small Trees: Small upright or spreading type, branched or pruned naturally according to species and type, and with relationship of caliper, height, and branching recommended by ANSI Z60.1, and stem form as specified in the Plant List on the drawings. Good structure shall be especially critical for trees. Grounds for rejection may include, but not limited to: improper branch density or distribution, "v" crotches, including bark, undesirable multiple leaders, leaders that have been topped or headed back, prevalent suckering or epicormic sprouting. Trees which have evidence of unevenly distributed, girdling or suckering roots may be rejected.

C. Provide balled and burlap trees unless noted otherwise on the drawings. Plants designated "B&B" in the plant list shall be balled and burlap. They shall be nursery grown and freshly dug. They shall be dug with firm, natural balls of earth of sufficient diameter and depth to encompass the fibrous and feeding root system necessary for full recovery of the plant. Balls shall be firmly wrapped with untreated biodegradable burlap and bound with twine, cord, or wire mesh basket. Plants shall not be accepted if the ball is dry, deformed or broken before or during the planting operations.

2.3 DECIDUOUS SHRUBS

A. Form and Size: Deciduous shrubs with not less than the minimum number of canes required by and measured according to ANSI Z60.1 for type, shape, and height of shrub.

B. Provide container grown shrubs unless noted otherwise on the drawings.

2.4 CONIFEROUS EVERGREENS

A. Form and Size: Specimen-quality, exceptionally heavy, tightly knit, symmetrically shaped coniferous evergreens.

B. Provide balled and burlap coniferous evergreens.

1. Container-grown coniferous evergreens will be acceptable in lieu of balled and burlap coniferous evergreens subject to meeting ANSI Z60.1 limitations for container stock and provided they are equal in quality and size to balled and burlap material.

2.5 BROADLEAF EVERGREENS

A. Form and Size: Normal-quality, well-balanced, broadleaf evergreens, of type, height, spread, and shape required, conforming to ANSI Z60.1.

B. Provide balled and burlap broadleaf evergreens.

1. Container-grown broadleaf evergreens will be acceptable in lieu of balled and burlap broadleaf evergreens subject to meeting ANSI Z60.1 limitations for container stock and provided they are equal in quality and size to balled and burlap material.

2.6 GRASS/LAWN MATERIALS

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with the Association of Official Seed Analysts' "Rules for Testing Seeds" for purity and germination tolerances.

Seed Mixture: Provide seed of grass species and varieties as specified in the plans and/or specifications.

Sod shall be as indicated on the plans and detail drawings. Provide machine cut, strongly rooted, certified turf grass sod, not less than two years old, free from weeds and undesirable native grasses and stripped not more than 24 hours before laying. Sod pad size shall be uniform thickness of 5/8", plus or minus ¼", measured at the time of cutting and excluding top growth and thatch.

2.7 TOPSOIL

A. Topsoil: ASTM D 5268, pH range of 5.5 to 7, 4 percent organic material minimum, free of stones 1 inch (25 mm) or larger in any dimension, and other extraneous materials harmful to plant growth. Sticks, roots, and clay clumps shall be removed from topsoil prior to spreading.

1. Topsoil Source: Reuse surface soil stripped and stockpiled on the site if adequate quantities exist. Verify suitability of surface soil to produce topsoil meeting requirements and amend when necessary. Screen topsoil of roots, plants, sods, stones greater than 1/2" diameter in general lawn areas and planting beds, clay lumps, and other extraneous materials harmful to plant growth. Screen topsoil prior to planting.

2.8 SOIL AMENDMENTS

A. Lime: ASTM C 602, Class T, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent, with a minimum 99 percent passing a No. 8 (2.36 mm) sieve and a minimum 75 percent passing a No. 60 (250 micrometer) sieve.

1. Provide lime in the form of dolomitic limestone.

B. Organic Compost: Organic compost of neutral character, decomposed, stable and weed-free meeting the US Composting Council standards.

C. Perlite: Horticultural perlite, soil amendment grade.

D. Peat Humus: Finely divided or granular texture, with a pH range of 6 to 7.5, composed of partially decomposed moss peat (other than sphagnum), peat humus, or reed-sedge peat.

E. Peat Humus: For acid-tolerant trees and shrubs, provide moss peat, with a pH range of 3.2 to 4.5, coarse fibrous texture, medium-divided sphagnum moss peat or reed-sedge peat.

F. Sawdust or Ground-Bark Humus: Decomposed, nitrogen-treated, of uniform texture, free of chips, stones, sticks, soil, or toxic materials.

1. When site treated, mix with at least 0.15 lb (2.4 kg) of ammonium nitrate or 0.25 lb (4 kg) of ammonium sulfate per cu. ft. (cu. m) of loose sawdust or ground bark.

G. Manure: Well-rotted, un-leached stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

H. Herbicides: EPA registered and approved, of type recommended by manufacturer.

Water: Potable.

Mycorrhizae: Applied to planting hole backfill or planting bed solid. Product shall be formulated for the moisture regime of the particular planting location (low, medium, high) contain a broad spectrum of mycorrhizae species, an organic bi-stimulant (2-2-2 preferred) and a water holding gel (low moisture locations only). Apply per manufacturer's recommendations.

2.9 FERTILIZER

A. Bonemeal: Commercial, raw, finely ground; minimum of 4 percent nitrogen and 20 percent phosphoric acid.

B. Superphosphate: Commercial, phosphate mixture, soluble; minimum of 20 percent available phosphoric acid.

C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea-form, phosphorous, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency and as needed to maintain plant material and lawns in a thriving condition.

D. Slow-Release Fertilizer: Granular fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency and as needed to maintain plant material and lawns in thriving condition.

2.10 MULCHES

A. Organic Mulch: Organic mulch, free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of the following:

1. Triple Shredded Hardwood Mulch: At least 80% hardwoods with moisture content of 30% or less, that can pass through a maximum screen size of 1 5/8". Raw material shall contain no yard waste, construction debris, or any other extraneous material.

a. Depth: 3" (after compaction)
b. Refer to plans for location.

2.11 EROSION-CONTROL MATERIALS

A. Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.

B. Fiber Mesh: Biodegradable twisted jute or spun-coir mesh, 0.92 lb per sq. yd. (0.5 kg per sq. m) minimum, with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.

2.12 STAKES AND GUYS

A. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, redwood, or pressure-preservative-treated softwood, free of knots, holes, cross grain, and other defects, 2 by 2 inches (50 by 50 mm) by length indicated, pointed at one end.

B. Use flexible Arbor tape or equivalent ¾" woven belt synthetic fabric strap installed per manufacturer's specifications. Color: Green.

C. Flags: Standard surveyor's plastic flagging tape, pink, 6 inches (150 mm) long.

NOTE: Clearly mark all guy wires with flagging for visibility, especially near recreation and pedestrian areas.

2.13 LANDSCAPE EDGINGS

"V" Ditch: A 4-inch deep trench by 6 inches width around all planting beds. Except where beds are adjacent to naturally wooded areas due to the possible damage to existing tree roots. Use care around existing tree roots in and around all planting beds. Do not cut existing tree roots to form the "V" ditch, work around them wherever possible.

2.14 MISCELLANEOUS MATERIALS

A. Anti-desiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's instructions. Apply as per nursery's recommendations. It should be applied prior to plant transport from the nursery where it is dug, if in full leaf.

2.15 TACKIFIER

Non-asphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

Asphalt emulsion in paragraph below may be used as a tackifier in a hydroseeding slurry or to temporarily bond straw mulch in place.

Asphalt Emulsion: ASTM D 977, Grade SS-1; nontoxic and free of plant-growth or germination in hibitors. (9 gals/1,000 SF).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive landscaping for compliance with requirements and for conditions affecting performance of work of this Section. Do not proceed with installation until unsatisfactory conditions have been corrected. Do not seed the site until the Landscape Architect has reviewed the final grades.

3.2 PREPARATION

A. Lay out individual tree and shrub locations and areas for multiple plantings. Entire areas for multiple plantings shall be chiseled to a depth of 12 inches and tilled and amended to a depth of 8 inches with the same soil mixture as is required for planting backfill material. Stake locations, outline areas, and secure Landscape Architect's acceptance before the start of planting work. Make minor adjustments as may be required.

3.3 PLANTING SOIL PREPARATION

A. Before mixing, clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth.

B. Mix soil amendments and fertilizers with topsoil at rates indicated. Delay mixing fertilizer if planting does not follow placing of planting soil within a few days.

C. For tree pit or trench backfill, mix planting soil before backfilling and stockpile at site.

D. For planting beds, mix planting soil prior to planting.

1. Mix lime with dry soil prior to mixing fertilizer. Prevent lime for lawn plantings from contacting roots of acid-tolerant plants.

E. Do not attempt soil preparation of plant installation when soils are frozen, wet, in poor tilth or otherwise unsuitable for planting.

3.4 LAWN PLANTING PREPARATION

A. Limit subgrade preparation to areas that will be planted in the immediate future.

B. Loosen subgrade to a minimum depth of 8 inches. Remove stones larger than 1/2 inch (19 mm) in any dimension and sticks, roots, rubbish, and other extraneous materials. Remove excess gravel which will inhibit lawn establishment and survival.

C. Spread topsoil to depth required to meet thickness, grades, and elevations shown, after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen.

1. Place approximately 1/2 the thickness of topsoil required. Work into top of loosened subgrade to create a transition layer and then place remainder of the topsoil.

D. Preparation of Unchanged Grades: Where lawns are to be planted in areas unaltered or undisturbed by excavating, grading, or surface soil stripping operations, prepare soil as follows:

1. Remove and dispose of existing grass, vegetation, and turf. Do not turn over into soil being prepared for lawns.
2. Till surface soil to a depth indicated on soil test report, but at a minimum of 6 inches (150 mm). Apply required soil amendments and initial fertilizers and mix thoroughly into top 4 inches (100 mm) of soil. Trim high areas and fill in depressions. Till soil to a homogenous mixture of fine texture.
3. Clean surface soil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth.
4. Remove waste material, including grass, vegetation, and turf, and legally dispose of it off the Owner's property.

E. Grade lawn and grass areas to a smooth, even surface with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future. Remove trash, debris, stones larger than 1 inch in any dimension (1/2 inch in playing fields), and other objects that may interfere with planting or maintenance operations. Remove all glass, wire or other objects of any size which may cause injury.

F. Moisten prepared lawn areas before planting when soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

G. Restore prepared areas if eroded or otherwise disturbed after fine grading and before planting.

H. Contact Owner and Landscape Architect for review and approval of seedbed preparation and seeding methods prior to and during seeding operations.

3.5 EXCAVATION FOR TREES AND SHRUBS

A. Pits and Trenches: Excavate with vertical sides and with bottom of excavation slightly raised at center to assist drainage. Loosen hard subsoil in bottom of excavation. Refer to planting details.

1. Place tree in pit by lifting and carrying the tree by its ball (never lift by branches or trunk) and then lowering it into the pit. Set the tree straight, plumb and in the center of the pit with the most desirable side of the tree facing the prominent view (sidewalk, building, street, etc.).
2. Determine the elevation of the root flare and ensure that it is planted at or slightly above finished grade. This may require that the tree be set higher than the grade in the nursery.
   If the root flare is less than 2-inches below the soil level of the root ball, plant the tree at the appropriate level above the grade, so the flare is even with the grade. If the flare is more than 2-inches at the center of the root ball above the grade, the tree shall be rejected.

B. Obstructions: Notify Landscape Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

C. Drainage: Notify Landscape Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub pits.

D. Fill excavations with water and allow to percolate out, before placing setting layer and positioning trees and shrubs.

3.6 PLANTING TREES AND SHRUBS

A. Set balled and burlap stock plumb and in center of pit or trench with top of ball raised above adjacent finish grades as indicated.

1. Place stock on setting layer of compacted planting soil.
2. Remove burlap from tops of balls and partially from sides, but do not remove from under balls. Remove the top 2/3's of the wire baskets. Remove pallets, if any, before setting. Do not use planting stock if ball is cracked or broken before or during planting operation.
3. Place backfill around ball in layers, tamping to settle backfill and eliminate voids and air pockets. When pit is approximately 1/2 backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing and tamping final layer of backfill.

B. Set container-grown stock plumb and in center of pit or trench with top of ball raised above adjacent finish grades as indicated.

1. Carefully remove containers so as not to damage root balls.
2. The root ball shall be loosened to alleviate matted or encircling roots. Roots shall be spread out evenly in an outward, radial fashion.
3. Place stock on setting layer of compacted planting soil.
4. Place backfill around ball in layers, tamping to settle backfill and eliminate voids and air pockets. When pit is approximately 1/2 backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing and tamping final layer of backfill.

C. Dish and tamp top of backfill to form a 3-inch- (75-mm-) high mound around the rim of the pit. Do not cover top of root ball with backfill.

D. Wrap trees of 2-inch (50-mm) caliper and larger with trunk-wrap tape if the species is susceptible to sun or wind scorch. Start at base of trunk and spiral cover trunk to height of first branches. Overlap wrap, exposing half the width, and securely attach without causing girdling. Inspect tree trunks for injury, improper pruning, and insect infestation and take corrective measures required before wrapping. Do not wrap the trees at the base to discourage insect infestation.

3.7 TREE AND SHRUB PRUNING

A. Prune, thin, and shape trees and shrubs as directed by Landscape Architect.

B. Only minimal pruning should be necessary at time of planting since plant material shall conform to the specified standards for quality. All pruning performed by the Contractor shall con-

form to the standards of the current ANSI A300, American National Standard for tree care operations. Under no circumstances shall the Contractor cut or prune leaders or remove more than 1/3 of the top without permission of the Landscape Architect. Prune to remove dead wood, crossovers, split or broken branches. Do not shorten, trim or clip branches solely for appearance purposes unless directed to by the Landscape Architect.

3.8 TREE AND SHRUB GUYING AND STAKING

A. Upright Staking and Tying: Stake trees of 2- through 5-inch (50- through 125-mm) caliper. Stake trees of less than 2-inch (50-mm) caliper only as required to prevent wind tip-out. Use a minimum of 2 stakes of length required to penetrate at least 18 inches (450 mm) below bottom of backfilled excavation and to extend at least 72 inches (1800 mm) above grade. Set vertical stakes and space to avoid penetrating balls or root masses. Support trees with 2 strands of flexible Arbor tape or equivalent ¾" woven belt synthetic fabric strap at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree. Flag heavily in recreation areas or any places where children are likely to be.

Note: Only upright staking of trees will be allowed around child play areas to avoid tripping hazards. Refer to the staking detail on the drawings.

3.9 MULCHING

A. Mulch backfilled surfaces of pits, trenches, planted areas, and other areas indicated.

B. Organic Mulch: Apply the following average thickness of organic mulch and finish level with adjacent finish grades. Do not place mulch against trunks or stems. Refer to section 2.10 for additional information.

1. Thickness: 4 inches (mulch depth shall be 3" after compaction and settling).

NOTE: Mulch shall NOT be from on-site chipping operations (unless specifically indicated in plans and specifications).

3.10 SEEDING NEW LAWNS

A. Sow seed with a spreader or a seeding machine. Do not broadcast or drop seed when wind exceeds 5 mph (8 km/h). Evenly distribute seed by sowing equal quantities in 2 directions at right angles to each other.

1. Do not use wet seed or seed that is moldy or otherwise damaged in transit or storage.

B. Sow seed at the rates required to achieve 95% coverage prior to Final completion as determined on a per square yard basis.

C. Rake seed lightly into top 1/8 inch (3 mm) of topsoil, roll lightly, and water with fine spray. Remove surface rocks of greater than 1" diameter.

D. Protect seeded slopes 6:1 (H:V) and steeper against erosion with erosion-control blankets installed and stapled according to manufacturer's recommendations.

E. Protect seeded areas with slopes flatter than 6:1 against erosion by spreading straw mulch after completion of seeding operations. Spread uniformly at a minimum rate of 2 tons per acre (45 kg per 100 sq. m) to form a continuous blanket 1-1/2 inches (38 mm) loose depth over seeded areas. Spread by hand, blower, or other suitable equipment. Tack with liquid asphalt tack (9 gals/1,000 SF) or non-asphaltic tackifier.

F. If seeding occurs in summer months, protect seeded areas against hot, dry weather or drying winds by applying peat mulch within 24 hours after completion of seeding operations. Soak and scatter uniformly to a depth of 3/16 inch (4.8 mm) thick and roll to a smooth surface.

3.11 HYDROSEEDING NEW LAWNS

A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogenous slurry suitable for hydraulic application.

1. Mix slurry with non-asphaltic tackifier.
2. Apply slurry uniformly to all areas to be seeded in a 2-step process. Apply first slurry application at the minimum rate of 500 lb per acre (5.5 kg per 100 sq. m) dry weight but not less than the rate required to obtain specified seed-sowing rate. Apply slurry cover coat of fiber mulch at a rate of 1000 lb per acre (11 kg per 100 sq. m).

3.12 RECONDITIONING LAWNS

A. Recondition existing lawn areas damaged by Contractor's operations, including storage of materials or equipment and movement of vehicles. Also recondition lawn areas where settlement or washouts occur or where minor regrading is required.

B. Remove sod and vegetation from diseased or unsatisfactory lawn areas; do not bury into soil. Remove topsoil containing foreign materials resulting from Contractor's operations, including oil drippings, fuel spills, stone, gravel, and other construction materials, and replace with new topsoil.

C. Where repairable lawn remains, as determined by the Owner, mow, dethatch, core aerate, and rake heavily and deeply. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.

D. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of it off the Owner's property.

E. Till stripped, bare, compacted or otherwise unrepairable areas thoroughly to a depth of 8 inches.

F. Apply required soil amendments and initial fertilizers and mix thoroughly into top 4 inches (100 mm) of soil. Provide new planting soil as required to fill low spots and meet new finish grades.

G. Apply seed and protect with straw mulch as required for new lawns.

H. Water newly planted areas and keep moist until new grass is established.

3.13 SODDING NEW LAWNS

A. Lay sod to form solid, uniform mass with tightly fitted joints. "Butt" ends and sides of sod strips. Do not overlap sod strips. Stagger strips to offset joints in adjacent courses. Lay sod strips across slopes and perpendicular to drainage flow. Tamp or roll lightly to ensure contact with subgrade.

B. Secure with pegs or staples at spacing recommended by the sod grower and supplier and as approved by the Landscape Architect and Owner. If pegs or staples are used for athletic fields, they shall be removed upon full establishment prior to final acceptance.

C. Water sod with fine spray immediately after planting. Water daily during first two weeks of establishment to maintain soil to depth of 4".

D. At no time shall sodded turf be allowed to grow over 3 inches in height. Throughout this period, the target mowing height shall be 1.5 inches. At no time shall more than 50% of the turf height be removed in any three-day period by mowing or other maintenance activity.

E. Sodded turf shall be fertilized according to the monthly application rates recommended in Carolina Lawns for the utilized grass or at reduced rate if instructed by the Landscape Architect.

F. Weed control shall be provided as necessary to prevent the establishment or proliferation of a weed species and to achieve acceptable turf at time of initial Acceptance.

G. Remove all poly mesh netting prior to placement and dispose of off-site.

3.14 INSTALLATION OF EDGINGS

A. "V" Ditches: Clearly delineate planting beds, play areas and sign locations with a 4-inch deep by 6-inch wide ditch. Lines shall be smooth. A minimum five-foot wide lawn strip shall be provided between planting beds and paved surfaces where shown on the drawings.

3.15 INSTALLATION OF MISCELLANEOUS MATERIALS

A. Apply anti-desiccant using power spray to provide an adequate film over trunks, branches, stems, twigs, and foliage.

1. When deciduous trees or shrubs are moved in full-leaf, spray with anti-desiccant at nursery before moving and again 2 weeks after planting.

3.16 INSPECTION AND ACCEPTANCE

A. When landscape work is completed, including maintenance, Architect will, upon written request, make a final inspection to determine acceptability.

B. At time of inspection for initial Acceptance, turf shall have been freshly mowed within the last 48 hours. Turf shall be healthy, of uniform color and exhibiting signs of good growth. A minimum of 95% of the specified seeding area shall be covered in established turf possessing both stolens (i.e. runners) and rhizomes. There shall be no bare areas greater than 4 sq. ft. or 1.5 ft. in any dimension. Seedling plants not having reached tiller stage (i.e. runner producing) shall be considered bare area. Turf shall be 100% free of noxious and perennial weeds and relatively free of annual weeds.

C. At time of inspection for initial Acceptance, sodded and sprigged turf shall have been freshly mowed within the last 48 hours. Turf shall be healthy, of uniform color and exhibiting good growth. A minimum of 100% of the specified turf area shall be covered in sod that has been installed for a minimum six weeks. Turf shall be 100% free of all weeds.

D. When inspected landscape work does not comply with requirements, replace rejected work and continue specified maintenance until re-inspected by Architect and found to be acceptable. Remove rejected plants and materials promptly from project site.

3.19 CLEANUP AND PROTECTION

A. During landscaping, keep pavements clean and work area in an orderly condition.

B. Protect landscaping from damage due to landscape operations, operations by other contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

3.20 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of it off the Owner's property unless an agreement is made with the Owner otherwise.

END OF SECTION 32 90 00

SECTION 32 91 10 – SAND CAPPED ROOTZONE MIX FOR ATHLETIC FIELDS

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes establishing sand capped rootzone mix for the athletic fields as indicated on the drawings.

B. Minimum thickness shall be as noted on the Drawings, for all proposed athletic field areas.

1.2 REFERENCE STANDARDS

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirement shall govern, unless otherwise directed by the Engineer.

1. American Society of Testing and Materials (ASTM):

    a. C 136 Sieve Analysis of Fine and Coarse Aggregates.
    b. D 422 Particle-Size Analysis of Soils.
    c. E 11 Wire-Cloth Sieve for Testing Purposes.
    d. F 2396-4 Guideline for High Performance Sand Based Sport Fields.

2. “Standard Specifications for Highway Materials and Methods of Sampling and Testing, American Association of State Highway and Transportation Officials (AASHTO).

1.3 SUBMITTALS

A. Supplier List: Submit list of procured and contracted suppliers of all materials required for the construction of the athletic field.

B. Material Certifications: Manufacturer's or vendor's certified analysis for:

1. Processed sand.
2. Organic amendments.
3. Fertilizer and chemical amendments.
4. Lime.

C. Product Data: Submit manufacturer's product data and samples as noted for the following:

1. Fertilizer and chemical amendments.

D. Samples: Submit samples of each of the following materials for review and approval prior to delivery to site:

1. Sand – 1-gallon (1 per 500 CY).

2. Organic Amendment – 1 gallon (1 per 500 CY).
3. Prepared Root Zone Mix – 1 gallon (1 per 500 CY).

E. Preliminary Fertility/Chemical Schedule:

1. Submit during construction and prior to grow-in. Schedule should include complete grow-in period up to the anticipated Substantial Completion date. This schedule as well as specific applications may be adjusted during the maintenance period as based on Fertility testing results, recommendations from the Owner's Testing Laboratory, climatic conditions, etc. Changes to the schedule shall be reviewed by the Engineer and Owner.

F. Provide Engineer with a complete list of equipment proposed to be used during rootzone placement. No heavy machinery or rubber-tired loaders will be permitted on the established subgrade. Utilize low pressure track machines only to move soil.

1.4 QUALITY ASSURANCE

A. All work shall be performed by one (1) Contractor with proven experience in sand capped athletic field construction.

B. Field & Fertility Testing Agent(s):

1. The Contractor shall utilize an independent Testing Agent, specializing in Natural Turf Pathology and Soil testing for Athletic Fields for all prequalification testing. The Testing Agent shall be A2LA accredited and be insured.
2. All costs associated with pre-qualification testing shall be the responsibility of the Contractor.
3. All costs associated with in-field testing shall be the responsibility of the Owner.
4. See 1.6 Quality Control for specific Field Testing requirements.

1.5 QUALITY CONTROL

A. Submit samples of each of the following materials for performance testing prior to shipping.

1. Rootzone Mix:
   a. Submit a one-gallon sample for every 300 cubic yards of rootzone mix to the Owner's Testing Laboratory for compliance with the specification.
2. Processed Sand:
   a. Submit a one-gallon sample for every 500 tons of sand amendment to the Owner's Testing Laboratory for compliance with the specification.
3. Organic Amendment:
   a. Submit a one-gallon sample for every 200 cubic yards of organic amendment to the Owner's Testing Laboratory for compliance with the specification.

B. Pre-bid Materials Inspection and Testing:

1. Bidders are encouraged to:

a. Pre-test sand materials with an independent Testing Agent prior to submitting a bid. This does not guarantee that the materials or source will be approved for construction.

2. All costs associated with pre-bid testing shall be borne by the bidder.

1.6 DELIVERY, STORAGE AND HANDLING

A. All materials shall be delivered and stored within the Contractor's work limits or in an area approved by the Owner.

B. All material shall be stored in strict accordance with the manufacturer's recommendations.

C. Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery, and while stored at site.

D. Amendments:

1. Deliver tested and approved lots in clean, washed and covered trucks to eliminate contamination during transportation. Place directly on playing field. Do not stockpile on site.

1.7 PROJECT CONDITIONS

A. Coordinate the placement of rootzone mix with the completion of all underground work including that of the other trades. The subgrade elevations shall be left within plus/minus .10 feet of the proposed subgrade elevations.

PART 2 – PRODUCTS

2.1 ROOTZONE MIX COMPONENTS AND PROTOCOL REPORTING

A. Components: For bidding purposes, the blend shall generally possess the ratios of 95% processed sand: 5% organic materials. The Testing Agent will have latitude during the mix design process to reasonably modify these ratios and to ultimately approve a final baseline specification mix as described earlier in this specification section. The materials used are as follows;

1. Processed Sand:

a. The sand shall be uniform coarse sand screened and washed meeting the following Particle Size Distribution (ASTM C136 and F1632 sand fractions % retained):

Fraction Size/Name	U.S. Standard Sieve	Diameter of Sieve (mm)	Allowable Range % Retained on Sieve
Gravel	10	2.00	3% maximum
Very Coarse Sand	18	1.00	less than, equal to 3 – 20%
Coarse Sand	35	0.50	At least 60%
Medium Sand	60	0.25	Particles in this range
Fine Sand	100	0.15	10% maximum
Very Fine Sand	270	0.05	5% maximum
Silt		0.002	5% maximum
Clay		<0.002	3% maximum

1) No more than 30% combined for No. 10 and No. 18 sieve.
2) 100% passing the No. 5 (4 mm) sieve, and no more than 15% combined very fine sand, silt, and clay.

2. Organic Amendments:
   a. General:
      1) The following components may be blended with the approved processed sand to make the final approved rootzone mixture.
   b. Processed Peat:
      1) Performance Criteria: If selected shall have a minimum organic matter content of 85% by weight as determined by loss on ignition (ASTM D 2974-87 Method D) and shall be free of sticks, stones, hay, or any other deleterious matter.
      2) Peat Analysis:

Parameter	Specification
Total Ash	15% or less
pH	6.5 to 7.5
% Moisture	40% to 70%

Sieve Criteria	
2.0 mm sieve	0 to 5% retained
1.0 mm sieve	Less than 20% retained

      3) Peat Suppliers:
         a) Fafard Peat, www.fafard.com.
         b) Peat Inc., Steve Young, (763)-441-8387.
         c) Oglebay Norton Industrial Sands, Inc. (619) 277-1670.
         d) Pioneer Peat, Inc. (701) 746-4300.

B. Rootzone Mix Requirements: The processed sand shall be uniform coarse sand screened and washed and when blended with the organic material by the Testing Agent shall be reported and meet the following requirements:

1. Particle Size Analysis meeting previous distribution chart.

2. Physical Analysis (determined at 25 cm tension – 10 inches by USGA testing protocol ASTM F1815) – multiple mixes may be shown to determine the final selection
   a. Saturated Hydraulic Conductivity – 10 to 16 in/hr.
   b. Total Porosity – 35 to 55% (Non capillary and Capillary).
   c. Bulk Density – 1.2 to 1.6 (ASTM F2396).
   d. Report Water Retention Percent at Field Capacity.
   e. pH range of 6.0 to 6.5 (ASTM D4972 Method A water only).
   f. Organic Matter Percent by weight for the mix shall be 0.4 to 0.6% (ASTM F1647 Method 1).
   g. Uniformity Coefficient (Cu): 2.0 – 5.0.
   h. Gradation Index (D90/D10): Less than 10.

C. Protocol and Reporting: The Testing Agent shall test the individual rootzone components and the blended mix(es) and report results using Full or Partial Protocol as follows:

1. Full Protocol Reporting: This full reporting shall be performed to verify/establish Baseline spec after the bid and prior to construction and for the first 3 batches of the mix during Construction Quality Control batch testing. Items to be reported are as follows:
   a. Particle Size Analysis / Distribution.
   b. Physical Analysis:
      1) Saturated Hydraulic Conductivity.
      2) Total Porosity (Non capillary and Capillary).
      3) Bulk Density.
      4) Report Water Retention Percent at Field Capacity.
      5) pH range.
      6) Organic Matter Percent by weight for the mix.
      7) Uniformity Coefficient (Cu):
      8) Gradation Index (D90/D10).
2. Partial Protocol Reporting: The remaining batches after the initial three during Construction Quality Control batch testing shall be tested and reported for the following unless it is determined at the sole discretion of the Owner or the Testing Agent to use the full protocol:
   a. Particle Size Distribution / Analysis.
   b. Uniformity Coefficient.
   c. Infiltration Rate.
3. Mix Adjustments and Recommendations: The Testing Agent shall make recommendations from the material reporting if necessary.
4. PH Recommendations
   a. Testing Agent shall make appropriate recommendations to modify the pH rating of the rootzone mx to establish an optimum range of 6.0 to 6.5 for sports turfgrass.

PART 3 – EXECUTION

3.1 EXAMINATION AND PROTECTION

A. Verification of Conditions: Examine areas and conditions under which all work of this Section is being performed. Do not proceed with any work until unsatisfactory conditions have been corrected. Commencement of work implies acceptance of all areas and conditions.

B. Protection of Work: Protect all on-going work, so as not to delay work due to weather or project related construction. This includes but is not limited to the use of tarps, geotextile, plywood and other protective measures.

C. Protection of Persons and Property: Provide all necessary measures to protect workmen and passersby. Barricade open excavations occurring as part of the work, as required by municipal or other authorities having jurisdiction.

1. Protect adjacent construction throughout the entire operation. Protect newly graded areas from destruction by weather or runoff. Protect structures, utilities, pavements, and other improvements from damage caused by settlement, lateral movement, undermining and washout.

D. Unanticipated Conditions: Notify the Engineer immediately upon finding evidence of previous structures, filled materials that penetrate below designated excavation levels, or other conditions which are not shown or which cannot be reasonably assumed from existing surveys and geotechnical reports.

3.2 PREPARATION OF SUBGRADE

A. Existing subgrade shall be scarified a minimum depth of 4 inches and cleared of stones greater than 2 inches, sticks, roots and other extraneous material prior to spreading rootzone.

B. The final elevation of the subgrade shall be within one-half inch on a 25 foot by 25 foot grid of the finished grades indicated on the Contract Drawings. Laser controlled or indicated equipment shall be used for this part of the work.

C. The final subgrade shall mirror the final finish elevation of the field surface regarding slope except where noted on the drawings.

D. The subgrade shall be loosened to 80% of the maximum dry density as determined by the standard proctor test.

3.3 ROOTZONE MIX INSTALLATION

A. All rootzone mix to be bulk mixed prior to installation to produce a consistent homogenous mixture for placement in athletic field areas.

B. A sample of the rootzone mixture in the proper rations shall be tested for particle size, permeability (Ksat), bulk density, aeration and capillary porosity, and organic matter content using ASTM F-1815-97 standard method prior to bulk mixing for placement.

C. Once mixing commences, samples shall be taken from the first 20 cubic yards, and every subsequent 300 cubic yards to confirm compliance with specified performance requirements.

D. Rootzone Mix shall not be spread until it is possible to follow within 72 hours with sodding operations.

E. Rootzone Mix shall not be placed when subgrade or rootzone mix are frozen, excessively wet or excessively dry. The Landscape Architect or the Owner's Representative may delay or reject rootzone placement if deemed appropriate based on field conditions.

F. Begin placement of rootzone mix only after irrigation system layout and installation have been approved and after verification that the finish grade of the subgrade conforms to the installation tolerances.

1. Depressions in the subgrade shall be removed/re-graded to a smooth surface prior to and during placement of rootzone material.

G. The approved rootzone mix shall be dumped at the edge of the field and systematically worked outward onto the field. Equipment used for placement of rootzone mix/field shall utilize turf type tires or low-pressure track equipment which will not damage or overly compact the field installation.

H. The rootzone mix shall be spread onto the field in an even depth as shown on the drawings within a tolerance of one-quarter inch. The finish grade slope shall conform exactly to the subgrade slope, (unless indicated otherwise on drawings) when the root zone mix has been spread uniformly over the field and compacted to 75% minimum to 82% maximum dry density as determined by the standard proctor test. The field shall be compacted, settled and firmed uniformly. Operate the irrigation system as necessary to settle and compact the mix to a final uniform depth.

I. Rootzone mix shall be placed it two equal lifts to ensure a minimum specified depth.

J. Finish grades shall be achieved by using a combination of laser-operated equipment, string lines, drag screens, rollers, and hand raking with a tolerance of 1/4 inch in 25 feet, non-cumulative.

3.4 FIELD QUALITY CONTROL

A. Subgrade Ground Surface Requirements:

1. Perform density tests in accordance with ASTM A1556, ASTM D2167, or ASTM D2022. Minimum one test per 5000 SF.
2. Perform moisture tests in accordance with ASTM D3017.
3. Where field-testing is performed using nuclear test methods, verify calibration of both density and moisture gages at the beginning of work, on each different type of material encountered, and additionally as directed by the Owner.

B. Contractor shall submit a complete maintenance schedule based on rootzone testing, recommendations by the testing agent and as discussed with the Owner's representative. This shall occur throughout the grow-in period and up to Substantial Completion.

C. Grade Verification: A certified survey shall be made of the as-built condition at the subgrade, rootzone mix for conformance to specified elevations.

D. Grade Verification: A certified survey shall be made of the as-built condition at subgrade, compacted rootzone mix, established turf field. A survey of the finished spot grades is to be developed by a State licensed surveyor over the entire surface in a 25-foot grid. The survey shall be certified (signed) and submitted to the Owner and its representatives for approval prior to installation of the grass material. In no event shall the Work contain depressions or other areas where water does not freely drain from the field

3.5 DISPOSAL OF EXCESS AND WASTE MATERIALS

A. Removal from Owner's Property: Remove waste materials, including materials not allowed for fill, backfill or site grading as specified within, trash, and debris, and dispose of it properly off Owner's property at Contractor's expense.

B. Leave the site in a clean, satisfactory condition ready to receive subsequent operations.

END OF SECTION 32 91 10

SECTION 32 92 26 – SPRIGGED ATHLETIC FIELDS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes preparation of ground surfaces, fertilizing, sprigging, mulching, and maintenance of turf areas as shown on the Drawings or as specified herein.

B. Sprigging (Bermuda) shall occur from May 15 to August 15, unless approved by the Engineer.

1.3 SUBMITTALS

A. Quality Control Submittals:

1. Certification:
    a. Submit manufacturer's or vendor's certified analysis for soil amendments and fertilizer materials to the Engineer.
    b. Submit vendor's certified analysis for each grass required, stating botanical and common name to Engineer.

B. Maintenance Instructions: Submit Contractor's maintenance procedures for the contract's entire maintenance length. Maintenance procedures must be submitted with the bid.

1.4 QUALITY ASSURANCE

A. All work shall be performed by one (1) Contractor, with proven expertise in this type of field construction.

B. Package standard products with the manufacturer's certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Agriculture Chemists, wherever applicable.

C. The Contractor shall provide and pay for all costs in connection with an approved independent testing facility to determine conformance of materials with the specifications.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver packaged materials in containers, showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery, and while stored on site.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Fertilizer:

1. Commercial starter fertilizer (19-26-5) with fine particles, chemically homogenous, having a minimum 75% of total nitrogen (19%) derived from urea and methylene ureas and a minimum of 26% monoammonium phosphate.
2. The POLY-S fertilizer shall be a 19-3-19* analysis, uniform particle size, have a minimum of 97% of the total nitrogen (19%) derived from polymer encapsulated coated urea, a minimum of 3% monoammonium phosphate and 19% from potassium sulfate.
3. The POLY-S product NPK Turf Fertilizer with Minors (19-3-19) shall be applied as specified.
4. Substitutions for 1-3 above will be allowed as approved by the Engineer.
5. Additional fertilizers or lime shall be applied (if required) per soil test recommendations.

B. Sprigs:

1. All sprigs shall be certified as to genetic purity and free from pests and disease. All sprigs shall cone from a nursery approved by the Engineer. The Bermuda grass sprigs shall be TifTuf, or approved equal.
2. All Bermuda grass shall have a minimum of eight (8) pounds live plant material per bushel and be free of weeds, dirt or foreign material and should maintain a length no longer than one and one-half inch (1-1/2”) per stolen.

C. Water: Clean and potable.

PART 3 – EXECUTION

3.1 PREPARATION OF ROOT ZONE MATERIAL

A. Mix starter fertilizer and POLY-S fertilizer into top 4 inches of root zone at a minimum rate of 6 lbs. per 1,000 square feet for the starter fertilizer and at a minimum rate of 7 lbs. per 1,000 square feet for the POLY-S fertilizer.

B. Water dry root zone to depth of 4 inches at least 48 hours prior to sprigging to obtain a loose friable planting bed.

C. The final planting bed must be smooth and surface free from water holding depressions or pockets.

D. Prior to commencing sprigging, the Engineer shall review and accept the final planting bed.

3.2 SPRIGGING

A. The Contractor shall provide and plant the grass sprigs by shredding the grass as the time of harvesting and by delivering it to the site and having it planted in the ground within 48 hours after it has been harvested. The grass will be planted by evenly distributing the sprigs, which

shall be placed into the ground with a straight-disc type planter customarily used in athletic fields. All areas will be rolled with a smooth-type roller after planting.

B. Apply sprigs at a rate of 400 bushels per acre if planted from May 15 to July 15, and 600 bushels per acre from July 15 to August 15.

C. Before sprigging, Contractor shall require the Engineer to review the areas prior to sprigging. This review shall in no way relieve the Contractor of his responsibilities regarding the preparation of the soil, grading, installation of the irrigation system and other Work required by the Contract Documents. All deficiencies noted by the Engineer shall be repaired prior to sprigging.

D. Sow remaining half of the sprig at right angles to the direction of the first sprigging pattern, using the same method.

E. Roll sprigged area with roller weighing no more than 150 pounds per foot of roller width.

F. Water sprigged areas to a depth of four (4) inches (10.16 cm) as required during the maintenance period.

3.3 PROTECTION

A. Erect warning signs and barricades (consisting of stakes with plastic tape) as required by the Engineer or Owner to protect newly planted areas from pedestrian and vehicular traffic. Maintain barricades throughout maintenance period until turf is accepted by the Owner. If requested by the Owner, Contractor shall remove the barricades prior to acceptance of the newly planted areas.

B. Repair or replace damaged landscape work as directed by Owner’s Representative.

3.4 MAINTENANCE

A. Include within the Contract Scope of Work and Contract Price the maintenance of turf immediately after each area is planted and continuing until 30 days after date of substantial completion for the Bermuda grass fields.

B. Maintain turf by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, re-grading, and replanting as required to establish a smooth acceptable turf, free of eroded or bare areas. Maintenance shall be in accordance with the maintenance manual submitted with the bid and approved by the engineer.

C. Resprig bare areas with the same materials specified for turf. Bermuda grass fields shall be re-sprigged if a rate of germination acceptable to the Owner and Engineer has not taken place within 4 weeks of sprigging. Areas greater than 2 square feet with little or no coverage will be re-sprigged.

D. Watering: The Contractor shall supplement natural precipitation to provide a total of 1.5 inches of water per week to all turf grass. Contractor shall be responsible for the germination and growth of sprigging as well as the general health of the turf.

E. Mow turf as soon as there is enough top growth to cut with mower set at specified height for principal species planted. Repeat mowing as required to maintain specified height. Remove no more than 35 percent of grass leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Time initial and subsequent mowings to maintain the following grass height: Mow Bermuda grass from 1 inch to ¾ inch height.

F. The Owner shall pay the cost of water for use in the irrigation system.

3.5 ACCEPTANCE

A. Work will be inspected for suitable coverage after 30 days from date of sprigging. Replant rejected work areas and continue specified maintenance until reinspected by the Engineer and Owner and found to be acceptable.

B. Replant rejected work and continue specified maintenance until reinspected by the Engineer and Owner and found to be acceptable.

C. Each field will be accepted in its entirety.

3.6 CLEANUP

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving the site to avoid tracking soil onto surface of roads, walks, or other paved areas.

END OF SECTION 32 92 26

SECTION 33 14 16

WATER DISTRIBUTION

PART 1 GENERAL

1.1 SUMMARY

The work under this section consists, in general, of furnishing all labor, materials, tools, equipment, and incidentals for providing for the water distribution system indicated on the project drawings and as specified herein.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION (AREMA)

AREMA Manual	(2006) Manual for Railway Engineering

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4	(2003) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110/A21.10	(2003) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	(2000) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115/A21.15	(2005) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C151/A21.51	(2002; Errata 2002) Ductile-Iron Pipe, Centrifugally Cast, for Water
AWWA C153/A21.53	(2006) Ductile-Iron Compact Fittings for Water Service
AWWA C500	(2002; R 2003) Metal-Seated Gate Valves for Water Supply Service
AWWA C502	(2005) Dry-Barrel Fire Hydrants
AWWA C509	(2001) Resilient-Seated Gate Valves for Water Supply Service
AWWA C600	(2005) Installation of Ductile-Iron Water Mains and Their Appurtenances

ASME INTERNATIONAL (ASME)

ASME B16.1	(2005) Gray Iron Pipe Flanges and Flanged Fittings (Classes 25, 125 and 250

ASTM INTERNATIONAL (ASTM)

ASTM A 536	(1984; R 2004) Standard Specification for Ductile Iron Castings
ASTM A 746	(2003) Standard Specification for Ductile Iron Gravity Sewer Pipe

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 24	(2006) Standard for the Installation of Private Fire Service Mains and Their Appurtenances

UNDERWRITERS LABORATORIES (UL)

UL 246	(1993; Rev thru Dec 1998) Hydrants for Fire-Protection Service
UL 262	(2004) Standard for Gate Valves for Fire-Protection Service

1.3 DESIGN REQUIREMENTS

1.3.1 Water Distribution Mains

Provide water distribution mains indicated as 4 through 12 inch diameter pipe sizes of ductile-iron pipe and/or PVC. Also provide water main accessories and gate valves as specified and where indicated.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01300, “Submittals.”

A. Product Data

1. Piping Materials
2. Water distribution main piping, fittings, joints, valves, and coupling
3. Hydrants
4. Valve boxes

Submit manufacturer's standard drawings or catalog cuts, except submit both drawings and cuts for push-on joints. Include information concerning gaskets with submittal for joints and couplings.

B. Design Data

1. Design calculations of water piping

C. Test Reports

1. Bacteriological Disinfection

Test results from commercial laboratory verifying disinfection

D. Certificates

1. Water distribution main piping, fittings, joints, valves, and coupling

2. Shop-applied lining

3. Fire hydrants

Certificates shall attest that tests set forth in each applicable referenced publication have been performed, whether specified in that publication to be mandatory or otherwise and that production control tests have been performed at the intervals or frequency specified in the publication. Other tests shall have been performed within 3 years of the date of submittal of certificates on the same type, class, grade, and size of material as is being provided for the project.

E. Manufacturer's Instructions

1. Delivery, storage, and handling

2. Installation procedures for water piping

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials on site in enclosures or under protective covering. Store rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes, fittings, valves and hydrants free of dirt and debris.

1.5.2 Handling

Handle pipe, fittings, valves, hydrants, and other accessories in a manner to ensure delivery to the trench in sound undamaged condition. Take special care to avoid injury to coatings and linings on pipe and fittings; make repairs if coatings or linings are damaged. Do not place any other material or pipe inside a pipe or fitting after the coating has been applied. Carry, do not drag pipe to the trench. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved

method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Owner. Store rubber gaskets that are not to be installed immediately, under cover out of direct sunlight.

1.5.3 Miscellaneous Plastic Pipe and Fittings

Handle Polyvinyl Chloride (PVC), pipe and fittings in accordance with the manufacturer's recommendations. Store plastic piping and jointing materials that are not to be installed immediately under cover out of direct sunlight.

PART 2 - PRODUCTS

2.1 WATER DISTRIBUTION MAIN MATERIALS

2.1.1 Piping Materials

2.1.1.1 Ductile-Iron Piping

a. Pipe and Fittings: Pipe, except flanged pipe, AWWA C151/A21.51, Pressure Class 250. Flanged pipe, AWWA C115/A21.15. Fittings, AWWA C110/A21.10 or AWWA C153/A21.53; fittings with push-on joint ends conforming to the same requirements as fittings with mechanical-joint ends, except that the bell design shall be modified, as approved, for push-on joint. Fittings shall have pressure rating at least equivalent to that of the pipe. Ends of pipe and fittings shall be suitable for the specified joints. Pipe and fittings shall have cement-mortar lining, AWWA C104/A21.4, standard thickness. Pipe shall be manufactured by **American Cast Iron Pipe Company**, **U.S. Pipe**, **Griffin Pipe Company** or approved equal. . Fittings shall be manufactured by **American Cast Iron Pipe Company**, **U.S. Pipe**, **Union Foundry**, **Sigma**, **Star Pipe** or approved equal.

b. Joints and Jointing Material:

(1) Joints: Joints for pipe and fittings shall be push-on joints or mechanical joints. Provide flanged joints where indicated.

(2) Push-On Joints: Shape of pipe ends and fitting ends, gaskets, and lubricant for joint assembly, AWWA C111/A21.11.

(3) Mechanical Joints: Dimensional and material requirements for pipe ends, glands, bolts and nuts, and gaskets, AWWA C111/A21.11.

(4) Flanged Joints: Bolts, nuts, and gaskets for flanged connections as recommended in the Appendix to AWWA C115/A21.15. Flange for setscrewed flanges shall be of ductile iron, ASTM A 536, Grade 65-45-12, and conform to the applicable requirements of ASME B16.1, Class 250. Setscrews for setscrewed flanges shall be 190,000 psi tensile strength, heat treated and zinc-coated steel. Gasket and lubricants for setscrewed flanges, in accordance with applicable requirements for mechanical-joint gaskets specified in AWWA C111/A21.11. Design of setscrewed gasket shall provide for confinement and compression of gasket when joint to adjoining flange is made.

(5) Insulating Joints: Designed to effectively prevent metal-to-metal contact at the joint between adjacent sections of piping. Joint shall be of the flanged type with insulating gasket, insulating bolt sleeves, and insulating washers. Gasket shall be of the dielectric type, full face, and in other respects as recommended in the Appendix to AWWA C115/A21.15. Bolts and nuts, as recommended in the Appendix to AWWA C115/A21.15.

2.1.1.2 Polyvinyl Chloride (PVC) Plastic Piping

A. Pipe and Fittings: Pipe, AWWA C900, shall be plain end or gasket bell end, Pressure Class 150 (DR 18) with cast-iron-pipe-equivalent OD.

B. Pipe for 1- 2-inch diameter water service lines shall be polyvinyl chloride (PVC) pressure rated pipe. The pipe shall conform to ASTM D 2241, shall have an SDR of 13.5 and a pressure rating of not less than 315 psi. The PVC material shall be designated as PVC 1120 and shall conform to ASTM D 1784. The joints shall be gasketed bell joints conforming to ASTM D 3139. All PVC pipe shall bear the National Sanitation Foundation (NSF) seal of approval for potable water use. No PVC pipe fittings shall be used in conjunction with the installation of water mains. A Pack Joint Coupling conforming to Model No. C87-77 by Ford Corporation shall be provided as recommended. All PVC pipe shall be wrapped in locator wire.

C. Pipe 14 through 36 diameter: AWWA C905.

D. Fittings for PVC pipe: Fittings shall be gray iron or ductile iron, AWWA C110/A21.10 or AWWA C153/A21.53, and have cement-mortar lining, AWWA C104/A21.4, standard thickness. Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, except that bell design shall be modified, as approved, for push-on joint suitable for use with PVC plastic pipe specified in this paragraph. Iron fittings and specials shall be cement-mortar lined in accordance with AWWA C104/A21.4. Fittings and specials may be of the same material as the pipe with elastomeric gaskets, all in conformance with AWWA C605 and AWWA C900.

E. Joints and Jointing Material: Joints for pipe shall be push-on joints, ASTM D3139. Joints between pipe and metal fittings, valves, and other accessories shall be push-on joints ASTM D3139, or compression-type joints/mechanical joints, ASTM D3139 and AWWA C111/A21.11. Provide each joint connection with an elastomeric gasket suitable for the bell or coupling with which it is to be used. Gaskets for push-on joints for pipe, ASTM F477. Gaskets for push-on joints and compression-type joints/mechanical joints for joint connections between pipe and metal fittings, valves, and other accessories, AWWA C111/A21.11, respectively, for push-on joints and mechanical joints. Mechanically coupled joints using a sleeve-type mechanical coupling, as specified in paragraph entitled "Sleeve-Type Mechanical Couplings," may be used as an optional jointing method in lieu of push-on joints on plain-end PVC plastic pipe, subject to the limitations specified for mechanically coupled joints using a sleeve-type mechanical coupling and to the use of internal stiffeners as specified for compression-type joints in ASTM D3139.

2.1.1.2 Piping Beneath Railroad Right-of-Way

Piping passing under the right-of-way of a commercial railroad shall conform to the specifications for pipelines conveying nonflammable substances in Chapter 1, Part 5 of the AREMA Manual, except for casing pipe, provide ductile-iron pipe in lieu of cast-iron

pipe. Ductile-iron pipe shall conform to and have strength computed in accordance with ASTM A 746.

2.1.2 Valves, Hydrants, and Other Water Main Accessories

2.1.2.1 Gate Valves on Buried Piping

AWWA C500, AWWA C509, or UL 262. Unless otherwise specified, valves conforming to: (1) AWWA C500 shall be nonrising stem type with double-disc gates and mechanical-joint ends or push-on joint ends as appropriate for the adjoining pipe, (2) AWWA C509 shall be nonrising stem type with mechanical-joint ends or resilient-seated gate valves 3 to 12 inches in size, and (3) UL 262 shall be inside-screw type with operating nut, double-disc or split-wedge type gate, designed for a hydraulic working pressure of 250 psi, and shall have mechanical-joint ends or push-on joint ends as appropriate for the pipe to which it is joined. Materials for UL 262 valves shall conform to the reference standards specified in AWWA C500. Valves shall open by counterclockwise rotation of the valve stem. Stuffing boxes shall have 0-ring stem seals. Stuffing boxes shall be bolted and constructed so as to permit easy removal of parts for repair. All gate valves shall be manufactured by **Mueller**, **M & H Valve** or **American-Flow Control**.

2.1.2.2 Fire Hydrants

Dry-barrel type. Paint hydrants with at least one coat of primer and two coats of RED enamel paint. Stencil hydrant number and main size on the hydrant barrel using black stencil paint.

a. All fire hydrants shall conform to the requirements of **AWWA C 502** for 150 psi working pressure. Hydrants shall be the compression type, closing with line pressure. The valve opening shall not be less than 4-1/2-inches.In the event of a traffic accident, the hydrant barrel shall break away from the standpipe at a point above ground and in a manner which will prevent damage to the barrel and stem, preclude opening of the valve, and permit rapid and inexpensive restoration without digging or cutting off the water. The means for attaching the barrel to the standpipe shall permit 360-degree rotation. Hydrants shall be fully bronze mounted with all working parts of bronze. Valve seat ring shall be bronze and shall screw into a bronze retainer. All working parts, including the seat ring shall be removable through the top without disturbing the barrel of the hydrant. The operating nut shall match those on existing hydrants. The operating threads shall be totally enclosed in an operating chamber separated from the hydrant barrel by a rubber O-ring stem seal and lubricated by grease or an oil reservoir. A stop nut shall be positioned in the top operating mechanism of the hydrant so that the valve stem cannot contact the bottom of the shoe when the hydrant is fully open. Minimum burial depth shall be 4.5 feet. Only one (1) extension kit per hydrant shall be allowed where necessary to bring the hydrant to the proper elevation. Extensions shall be installed in accordance with manufacturer's recommendations. The centerline of the 2-1/2-inches connections shall be a minimum of 18-inches above finished grade.Hydrants shall be non-freezing design and provided with a simple, positive and automatic drain, which shall be fully closed whenever the main valve is opened. Hose and pumper connections shall be breech-locked, pinned, or threaded and pinned to seal them into the hydrant barrel. Each hydrant shall have two (2), 2-1/2- inch fire hose connections and one (1), 4-1/2- inch pumper connection; all with National Standard threads and each equipped with cap and non-kinking chain.

Fire hydrants shall be **Mueller A 421 M.J.**, **American-Flow Control MK-73-5 M.J.**, and **M&H 129 M.J.**

2.1.2.3 Valve Boxes

Provide a valve box for each gate valve on buried piping. All valve boxes, covers and risers shall be cast or ductile iron. Valve boxes shall be two-piece heavy duty and meet H20 loading standards with inside diameter of barrel not less than 5-inches. Valve box assemblies shall be the extension screw-type with flared base and shall be of such length as will be adapted without full extension. Valve boxes shall be Sigma Corporation Catalog No. VB-261or VB-262 or approved equal. Valve box covers shall meet H20 loading standards and weigh a minimum of 13 pounds. The word “WATER” shall be cast on the cover. Valve covers shall be Sigma Corporation Catalog No. VB-2600 or approved equal. Valve box riser extensions shall be made of 6” ductile iron pipe and shall meet H20 heavy duty loading standards. Valve riser extensions shall be Sigma Corporation Catalog No. VB-2601 or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPELINES

3.1.1 General Requirements for Installation of Pipelines

These requirements shall apply to all pipeline installation except where specific exception is made in the "Special Requirements..." paragraphs.

3.1.1.1 Location of Water Lines

Terminate the work covered by this section as indicated. Do not lay water lines in the same trench with gas lines, fuel lines, or electric wiring.

a. Water Piping Installation Parallel With Sewer Piping

(1) Normal Conditions: Lay water piping at least 10 feet horizontally from a sewer or sewer manhole whenever possible. Measure the distance edge-to-edge.

(2) Unusual Conditions: When local conditions prevent a horizontal separation of 10 feet, the water piping may be laid closer to a sewer or sewer manhole provided that:

(a) The bottom (invert) of the water piping shall be at least 18 inches above the top (crown) of the sewer piping.

(b) Where this vertical separation cannot be obtained, the sewer piping shall be constructed of AWWA-approved water pipe and pressure tested in place without leakage prior to backfilling. Approved waste water disposal method shall be utilized.

(c) The sewer manhole shall be of watertight construction and tested in place.

b. Installation of Water Piping Crossing Sewer Piping

(1) Normal Conditions: Water piping crossing above sewer piping shall be laid to provide a separation of at least 18 inches between the bottom of the water piping and the top of the sewer piping.

(2) Unusual Conditions: When local conditions prevent a vertical separation described above, use the following construction:

(a) Sewer piping passing over or under water piping shall be constructed of AWWA-approved ductile iron water piping, pressure tested in place without leakage prior to backfilling.

(b) Water piping passing under sewer piping shall, in addition, be protected by providing a vertical separation of at least 18 inches between the bottom of the sewer piping and the top of the water piping; adequate structural support for the sewer piping to prevent excessive deflection of the joints and the settling on and breaking of the water piping; and that the length, minimum 20 feet, of the water piping be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer piping.

(c) Sewer Piping or Sewer Manholes: No water piping shall pass through or come in contact with any part of a sewer manhole.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section 31 00 00, “Earthwork,” and as noted below:

3.1.1.2.1 Bedding

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

3.1.1.2.2 Backfilling

3.1.1.2.3 Backfilling Pipe in Trenches

After the pipe has been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 6 inches in compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation of at least 12 inches above the top of the pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 8 inches. Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the Owner, that sheeting or portions of bracing used be left in place, the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

3.1.1.2.4 Movement of Construction Machinery

When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

3.1.1.2.5 Compaction

3.1.1.2.5.1 General Requirements

Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils will show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

3.1.1.2.5.2 Minimum Density

Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to the following applicable minimum density, which will be determined as specified below.

A. Under pavements including adjacent shoulder areas, the density shall be not less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material, up to the elevation where requirements for pavement subgrade materials and compaction shall control.

B. Under unpaved or turfed traffic areas, density shall not be less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material.

C. Under nontraffic areas, density shall be not less than that of the surrounding material.

3.1.1.2.5.3 Determination of Density

Testing shall be the responsibility of the Contractor and performed at no additional cost to the Owner. Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. Tests shall be performed in sufficient number to ensure that specified density is being obtained. Laboratory tests for moisture-density relations shall be made in accordance with ASTM D 1557 except that mechanical tampers may be used provided the results are correlated with those obtained with the specified hand tamper. Field density tests shall be determined in accordance with ASTM D 2167 or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted, if necessary, using the sand cone method as described in paragraph Calibration of the referenced publications. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017 or ASTM D 2922. Test results shall be furnished the Owner. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered at intervals as directed.

3.1.1.3 Pipe Laying and Jointing

Remove fins and burrs from pipe and fittings. Before placing in position, clean pipe, fittings, valves, and accessories, and maintain in a clean condition. Provide proper facilities for lowering sections of pipe into trenches. Do not under any circumstances drop or dump pipe, fittings, valves, or any other water line material into trenches. Cut pipe in a neat workmanlike manner accurately to length established at the site and work into place without springing or forcing. Replace by one of the proper length any pipe or fitting that does not allow sufficient space for proper installation of jointing material. Blocking or wedging between bells and spigots will not be permitted. Lay bell-and-spigot pipe with the bell end pointing in the direction of laying. Grade the pipeline in straight lines; avoid the formation of dips and low points. Support pipe at proper elevation and grade. Secure firm, uniform support. Wood support blocking will not be permitted. Lay pipe so that the full length of each section of pipe and each fitting will rest solidly on the pipe bedding; excavate recesses to accommodate bells, joints, and couplings. Provide anchors and supports where necessary for fastening work into place. Make proper provision for expansion and contraction of pipelines. Keep trenches free of water until joints have been properly made. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Do not lay pipe when conditions of trench or weather prevent installation. Depth of cover over top of pipe shall not be less than 2 1/2 feet.

3.1.1.4 Installation of Tracer Wire

Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe. Attach wire to top of pipe in such a manner that it will not be displaced during construction operations.

3.1.1.5 Connections to Existing Water Lines

Make connections to existing water lines after approval is obtained and with a minimum interruption of service on the existing line. Make connections to existing lines under pressure in accordance with the recommended procedures of the manufacturer of the pipe being tapped.

3.1.2 Special Requirements for Installation of Water Mains

3.1.2.1 Installation of Ductile-Iron Piping

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the requirements of AWWA C600 for pipe installation, joint assembly, valve-and-fitting installation, and thrust restraint.

a. Jointing: Make push-on joints with the gaskets and lubricant specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly. Make mechanical joints with the gaskets, glands, bolts, and nuts specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly and the recommendations of Appendix A to AWWA C111/A21.11. Make insulating joints with the gaskets, sleeves, washers, bolts, and nuts previously specified for this type joint. Assemble insulating joints as specified for flanged joints, except that bolts with insulating sleeves shall be full size for the bolt holes. Ensure that there is no metal-to-metal contact between dissimilar metals after the joint has been assembled.

b. Allowable Deflection: The maximum allowable deflection shall be as given in AWWA C600. If the alignment requires deflection in excess of the above

limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth.

c. Pipe Anchorage: Provide metal harness for pipe anchorage. Metal harness shall be in accordance with the requirements of AWWA C600 for thrust restraint, using tie rods and clamps as shown in NFPA 24.

d. Exterior Protection: Completely encase buried ductile iron pipelines with polyethylene tube or sheet, using polyethylene film, in accordance with AWWA C105/A21.5.

3.1.2.2 Installation of Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the applicable requirements of ASTM D 2774 and ASTM D 2855, unless otherwise specified. Handle solvent cements used to join plastic piping in accordance with ASTM F 402.

A. Jointing: Make solvent-cemented joints for PVC plastic piping using the solvent cement previously specified for this material; assemble joints in accordance with ASTM D 2855. Make plastic pipe joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

B. Plastic Pipe Connections to Appurtenances: Connect plastic pipe service lines to gate valves in accordance with the recommendations of the plastic pipe manufacturer.

3.1.2.3 Installation of Valves and Hydrants

a. Installation of Valves: Install gate valves, AWWA C500 and UL 262, in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C500. Install gate valves, AWWA C509, in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C509. Make and assemble joints to gate valves as specified for making and assembling the same type joints between pipe and fittings.

b. Installation of Hydrants: Install hydrants in accordance with AWWA C600 for hydrant installation and as indicated. Make and assemble joints as specified for making and assembling the same type joints between pipe and fittings. Provide metal harness as specified under pipe anchorage requirements for the respective pipeline material to which hydrant is attached. Install hydrants with the 4 1/2 inch connections facing the adjacent paved surface.

3.1.2.4 Installation Beneath Railroad Right-of-Way

Install piping passing under the right-of-way of a railroad in accordance with the specifications for pipelines conveying nonflammable substances in Chapter 1, Part 5, of the AREMA Manual.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

Prior to hydrostatic testing, obtain Owner approval of the proposed method for disposal of waste water from hydrostatic testing. The Owner will conduct field inspections and witness field tests specified in this section. The Owner shall perform field tests, and provide labor, equipment, and incidentals required for testing, except that water and electric power needed for field tests will be furnished as set forth in The General Conditions. The Contractor shall produce evidence, when required, that any item of work has been constructed in accordance with the drawings and specifications. Do not begin testing on any section of a pipeline where concrete thrust blocks have been provided until at least 5 days after placing of the concrete.

3.2.2 Testing Procedure

Test water mains and water service lines in accordance with the applicable specified standard, except for the special testing requirements given in paragraph entitled "Special Testing Requirements." Test ductile-iron water mains and water service lines in accordance with the requirements of AWWA C600 for hydrostatic testing. The amount of leakage on ductile-iron pipelines with mechanical-joints or push-on joints shall not exceed the amounts given in AWWA C600; no leakage will be allowed at joints made by any other method. Test PVC plastic water mains and water service lines made with PVC plastic pipe in accordance with the requirements of UBPPA UNI-B-3 for pressure and leakage tests. The amount of leakage on pipelines made of PVC plastic water pipe shall not exceed the amounts given in UBPPA UNI-B-3, except that at joints made with sleeve-type mechanical couplings, no leakage will be allowed. Test water service lines in accordance with applicable requirements of AWWA C600 for hydrostatic testing. No leakage will be allowed at flanged joints.

3.2.3 Special Testing Requirements

For pressure test, use a hydrostatic pressure 50 psi greater than the maximum working pressure of the system, except that for those portions of the system having pipe size larger than 2 inches in diameter, hydrostatic test pressure shall be not less than 200 psi. Hold this pressure for not less than 2 hours. Prior to the pressure test, fill that portion of the pipeline being tested with water for a soaking period of not less than 24 hours. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.

3.3 CLEANUP

Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

End of Section 33 14 16

SECTION 33 31 13

SANITARY SEWERS

PART 1 – GENERAL

1.1 SUMMARY

The work under this section consists, in general, of furnishing all labor, materials, tools, equipment, and incidentals for providing the sanitary sewer collection system indicated on the construction drawings and as specified herein.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. The most current version of the following references applies.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 443	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C 478	Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C 990	Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM D 3034	Standard Specification for Rigid Poly Vinyl Chloride (PVC) Compounds and Chlorinated Poly Vinyl Chloride) (CPVC) Compounds
ASTM D 2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2412	Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
ASTM D 3034	Standard Specification for Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings
ASTM D 3212	Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

ASTM F 477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

1.3 SYSTEM DESCRIPTION

1.3.1 Sanitary Sewer Gravity Pipeline

Provide mains and laterals of polyvinyl chloride (PVC) plastic pipe. Provide building connections of polyvinyl chloride (PVC) plastic pipe. Provide new exterior sanitary gravity sewer piping and appurtenances. Provide each system complete and ready for operation. The exterior sanitary gravity sewer system includes equipment, materials, installation, and workmanship as specified herein more than 5 feet outside of building walls.

1.3.2 Sanitary Sewer Pressure Lines

Provide pressure lines of polyvinyl chloride (PVC) plastic pressure pipe.

1.4 GENERAL REQUIREMENTS

The construction required herein shall include appurtenant structures and building sewers to points of connection with the building drains 5 feet outside the building to which the sewer system is to be connected. The Contractor shall replace damaged material and redo unacceptable work at no additional cost to the Owner. Backfilling shall be accomplished after inspection by the Owner. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Owner. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install the plastic pipe shall be stored in accordance with the manufacturer's recommendation and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.5 SUBMITTALS

1.5.1 Shop Drawings

A. Drawings

Installation and As-Built drawings, as specified.

B. Precast concrete manholes

C. Cleanouts

D. Frames and covers

Details, as specified.

1.5.2 Product Data

A. Pipeline materials

Submit manufacturer's standard drawings or catalog cuts.

1.5.3 Test Reports

A. Reports

Test and inspection reports, as specified.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Delivery and Storage

1.6.1.1 Piping

Inspect materials delivered to site for damage; store with minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping and jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

1.6.1.2 Metal Items

Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.

1.6.2 Handling

Handle pipe, fittings, and other accessories in such manner as to ensure delivery to the trench in sound undamaged condition. Carry, do not drag, pipe to trench.

PART 2 – PRODUCTS

2.1 PIPELINE MATERIALS

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 PVC Plastic Gravity Sewer Piping

2.1.1.1 PVC Plastic Gravity Pipe and Fittings

ASTM D 3034, SDR 26 with ends suitable for elastomeric gasket joints.

2.1.1.2 PVC Plastic Gravity Joints and Jointing Material

Joints shall conform to ASTM D 3212. Gaskets shall conform to ASTM F 477.

2.1.2.1 PVC Plastic Pressure Pipe and Fittings

Pipe and Fittings Less than 4-inch Diameter: Pipe, couplings and fitting shall be manufactured of materials conforming to ASTM D1784, Class 1245B.

Screw-Joint: Pipe shall conform to dimensional requirements of ASTM D1785, Schedule 80, with joints meeting requirements of 150 psi working pressure, 200 psi hydrostatic test pressure, unless otherwise shown or specified. Fittings for threaded pipe shall conform to requirements of ASTM D2464, threaded to conform to the requirements of ASME B1.20.2M ASME B1.20.1 for use with Schedule 80 pipe and fittings. Pipe couplings when used, shall be tested as required by ASTM D2464.

Push-On Joint: ASTM D3139, with ASTM F477 gaskets. Fittings for push-on joints shall be iron conforming to AWWA C110/A21.10 or AWWA C111/A21.11. Iron fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA C104/A21.4.

Solvent Cement Joint: Pipe shall conform to dimensional requirements of ASTM D1785 or ASTM D2241

2.2 DOSING TANKS

A. Dosing Tanks: Comply with ASTM F1759-97 for high density polyethylene (HDPE) tank and cover;

1. Design: For effluent pump automatic siphon installation and A-16 (HS20-44) traffic loading according to ASTM C 890.
2. Manholes: 20-inch minimum diameter opening with reinforced risers to grade and access lid with steel lift rings. Include manhole in center of each septic tank compartment top.
3. Resilient Connectors: ASTM C 923, of size required for piping, fitted into inlet and outlet openings.

B. Capacity and Characteristics:

1. Type: High Density Polyethylene (HDPE) dosing tank.
2. Capacity: As Shown on plans.
3. Inlet and Outlet Size: As Shown on plans.

2.3 EFFLUENT PUMPS

A. Description: Single-stage, centrifugal, end-suction, submersible, direct-connected effluent pump complying with UL 778 and with HI 1.1-1.2 and HI 1.3 for submersible sewage pumps.

1. Manufacturers:
   a. ABS Pumps, Inc.
   b. E-One Sewer System (Model DR/DH 152)
   c. Flygt; ITT Industries.
   d. Goulds Pumps; ITT Industries.
   e. Myers, F. E.; Pentair Pump Group (The).
   f. Stancor, Inc.
   g. Sta-Rite Industries, Inc.
   h. Zoeller Company. (Model #BN 270)

2. Pumps: Duplex arrangement.

   a. Casing: Cast iron, with open inlet and legs or base that elevate pump to permit flow into impeller, and discharge companion flange arranged for vertical discharge.
   b. Impeller: ASTM A 48/A 48M, Class No. 25 A or higher cast iron; statically and dynamically balanced, closed or semi-open design, overhung, single suction, and keyed and secured to shaft.

c. Pump and Motor Shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings and mechanical seals.

3. General requirements for motors are specified:
   a. Motors: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor waterproof power cable of length required, with grounding plug and cable-sealing assembly for connection at pump.
   b. Moisture-Sensing Probe: Internal moisture sensor, moisture alarm, and waterproof cable of length required, with cable-sealing assembly for connection at pump.
   c. Motor Housing Fluid: Oil.
   d. 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.
   e. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

4. Pump Discharge Piping: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe; ASME B16.4, Class 125, gray-iron fittings; and threaded joints.

5. Controls: NEMA 250, Type 4X wall-mounting enclosure with two mechanical, mercury-float, micro-pressure or mechanical-float switches in NEMA 250, or Type 6 enclosures; mounting rod; and electric cable

6. Controls: NEMA 250, Type 4X wall-mounting enclosure with three mechanical-float switches in NEMA 250, or Type 6 enclosures; mounting rod; and electric cables. Include automatic alternator to alternate operation of pump units on successive cycles and to operate both units if one pump cannot handle load.

B. Capacity and Characteristics:

1. Each Pump:
   a. Capacity: 10 GPM
   b. Total Dynamic Head: 20 Feet.
   c. Speed: 1,725 RPM
   d. Discharge Pipe Size: 1-1/4”
   e. Motor Horsepower: 1.0 HP
   f. Electrical Characteristics:
      1) Volts: 120/240 V
      2) Phases: Single phase.
      3) Hertz: 60 Hz.

2. Total Effluent Pump Unit Electrical Data:
   a. Full-Load Amperes: 8.5 A.
   b. Minimum Circuit Ampacity: A.
   c. Maximum Overcurrent Protection: A.

2.4 MISCELLANEOUS MATERIALS

2.4.1 Precast Concrete Manholes

Precast concrete manhole risers, base sections, and tops shall conform to ASTM C 478 and be manufactured in accordance with Section 03 41 00 PRECAST CONCRETE; base and first riser shall be monolithic.

2.4.2 Gaskets and Connectors

Gaskets for joints between manhole sections shall conform to ASTM C 443. Resilient connectors for making joints between manhole and pipes entering manhole shall conform to ASTM C 990.

2.4.3 External Preformed Rubber Joint Seals

An external preformed rubber joint seal shall be an accepted method of sealing cast iron covers to precast concrete sections to prevent ground water infiltration into sewer systems. The seal shall be multi-section with a neoprene rubber top section and all lower sections made of Ethylene Propylene Di Monomer (EPDM) rubber with a minimum thickness of 60 mils. Each unit shall consist of a top and bottom section and shall have mastic on the bottom of the bottom section and mastic on the top and bottom of the top section. The mastic shall be a non-hardening butyl rubber sealant and shall seal to the cone/top slab of the manhole/catch basin and over the lip of the casting. Extension sections shall cover up to two more adjusting rings.

2.4.4 Metal Items

2.4.4.1 Frames, Covers, and Gratings for Manholes

Frames and covers shall be cast iron. Cast iron frames and covers shall be as indicated or shall be of type suitable for the application, circular, without vent holes. The frames and covers shall have a combined weight of not less than 400 pounds. The word "Sewer" shall be stamped or cast into covers so that it is plainly visible.

2.4.4.2 Manhole Steps

Zinc-coated steel conforming to 29 CFR 1910.27. Aluminum steps or rungs will not be permitted. Steps are not required in manholes less than 4 feet deep.

2.5 REPORTS

Submit Test Reports. Compaction and density test shall be in accordance with Section 31 23 13 EXCAVATION AND FILL. Submit Inspection Reports for daily activities during the installation of the sanitary system. Information in the report shall be detailed enough to describe location of work and amount of pipe laid in place, measured in linear feet.

PART 3 – EXECUTION

3.1 INSTALLATION OF PIPELINES AND APPURTENANT CONSTRUCTION

3.1.1 General Requirements for Installation of Pipelines

These general requirements apply except where specific exception is made in the following paragraphs entitled "Special Requirements."

3.1.1.1 Location

The work covered by this section shall terminate at a point approximately 5 feet from the building.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section 31 23 13.

3.1.1.3 Pipe Laying and Jointing

Inspect each pipe and fitting before and after installation; replace those found defective and remove from site. Provide proper facilities for lowering sections of pipe into trenches. Lay pipe with the bell ends in the upgrade direction. Adjust spigots in bells to give a uniform space all around. Blocking or wedging between bells and spigots will not be permitted. Replace by one of the proper dimensions, pipe or fittings that do not allow sufficient space for installation of joint material. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Provide batterboards not more than 25 feet apart in trenches for checking and ensuring that pipe invert elevations are as indicated. Laser beam method may be used in lieu of batterboards for the same purpose.

3.1.2 Special Requirements

3.1.2.1 Installation of PVC Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of ASTM D 2321 for laying and joining pipe and fittings. Make joints with the gaskets specified for joints with this piping and assemble in accordance with the requirements of ASTM D 2321 for assembly of joints. Make joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

3.1.2.2 Installation of PVC Plastic Pressure Pipe and Fittings

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled “General Requirements for Installation of Pipelines” of this section; with the requirements of AWWA C605 for laying of pipe, joining PVC pipe to fittings and accessories, and setting of hydrants, valves, and fittings; and with the recommendations for pipe joint assembly and appurtenance installation in AWWA M23, Chapter 7, “Installation.”

Pipe Less than 4-inch Diameter:

Threaded joints shall be made by wrapping the male threads with joint tape or by applying an approved thread lubricant, then threading the joining members together. The joints shall be tightened with strap wrenches which will not damage the pipe and fittings. The joint shall be tightened no more than 2 threads past hand-tight.

Push-On Joints: The ends of pipe for push-on joints shall be beveled to facilitate assembly. Pipe shall be marked to indicate when the pipe is fully seated. The gasket shall be lubricated to prevent displacement. Care shall be exercised to ensure that the gasket remains in proper position in the bell or coupling while making the joint.

Solvent-weld joints shall comply with the manufacturer’s instructions.

3.1.3 Manhole Construction

For precast concrete construction, make joints between manhole sections with the gaskets specified for this purpose; install in the manner specified for installing joints in concrete piping. Parging will not be required for precast concrete manholes. Make joints between concrete manholes and pipes entering manholes with the resilient connectors specified for this purpose; install in accordance with the recommendations of the connector manufacturer.

3.1.4 Miscellaneous Construction and Installation

3.1.4.1 Connecting to Existing Manholes

Pipe connections to existing manholes shall be made so that finish work will conform as nearly as practicable to the applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping. The connection shall be centered on the manhole. Holes for the new pipe shall be of sufficient diameter to allow packing cement mortar around the entire periphery of the pipe but no larger than 1.5 times the diameter of the pipe. Cutting the manhole shall be done in a manner that will cause the least damage to the walls.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

The Owner will conduct field inspections and witness field tests specified in this section. Perform field tests and provide labor, equipment, and incidentals required for testing. Be able to produce evidence, when required, that each item of work has been constructed in accordance with the drawings and specifications.

3.2.2 Tests for Nonpressure Lines

Check each straight run of pipeline for gross deficiencies by holding a light in a manhole; it shall show a practically full circle of light through the pipeline when viewed from the adjoining end of line.

3.2.2.1 Leakage Tests

Test lines for leakage by either infiltration tests or exfiltration tests, or by low-pressure air tests. Prior to testing for leakage, backfill trench up to at least lower half of pipe. When necessary to prevent pipeline movement to prevent testing, place additional backfill around pipe sufficient to prevent movement, but leaving joints uncovered to permit inspection. When leakage or pressure drop exceeds the allowable amount specified, make satisfactory correction and retest pipeline section in the same manner. Correct visible leaks regardless of leakage test results.

a. Infiltration tests and exfiltration tests: Perform these tests for sewer lines made of the specified materials, not only concrete, in accordance with ASTM C969. Make calculations in accordance with the Appendix to ASTM C969.
b. Low-pressure air tests: Perform tests as follows:

   PVC plastic pipelines: Test in accordance with UBPPA UNI-B-6. Allowable pressure drop shall be as given in UBPPA UNI-B-6. Make calculations in accordance with the Appendix to UBPPA UNI-B-6.

3.2.2.2 Deflection Testing

Perform a deflection test on entire length of installed plastic pipeline on completion of work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads determined in accordance with ASTM D 2412. Deflection of pipe in the installed pipeline under external loads shall not exceed 4.5 percent of the average inside diameter of pipe. Determine whether the allowable deflection has been exceeded by use of a pull-through device or a deflection measuring device.

Deflection measuring device: Sensitive to 1.0 percent of the diameter of the pipe being tested and shall be accurate to 1.0 percent of the indicated dimension. Deflection measuring device shall be approved prior to use.

3.2.3 Tests for Pressure Lines

Test pressure lines in accordance with the applicable standard specified in this paragraph, except for test pressures. For hydrostatic pressure test, use a hydrostatic pressure 50 psi in excess of the maximum working pressure of the system, but not less than 100 psi, holding the pressure for a period of not less than one hour. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.

****END OF SECTION 33 31 13*****

SECTION 33 40 00

STORM DRAINAGE

PART 1 - GENERAL

1.1 SUMMARY

The work under this section consists, in general, of furnishing all labor, materials, tools, equipment, and incidentals for providing for the installation of drop inlets, reinforced concrete pipe drains, pipe drains of other materials, and other related utilities.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO HB-17	(2002; Errata 2003; Errata 2005, 17th Edition) Standard Specifications for Highway Bridges
AASHTO M 167M/M 167	(2009) Standard Specification for Corrugated Steel Structural Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches
AASHTO M 190	(2004; R 2012) Standard Specification for Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches
AASHTO M 243	(1996; R 2012) Standard Specification for Field-Applied Coating of Corrugated Metal Structural Plate for Pipe, Pipe-Arches, and Arches
AASHTO M 294	(2013) Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm Diameter

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION (AREMA)

AREMA Eng Man	(2012) Manual for Railway Engineering

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2012) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A48/A48M	(2003; R 2012) Standard Specification for Gray Iron Castings
ASTM A536	(1984; R 2009) Standard Specification for Ductile Iron Castings
ASTM A716	(2008) Standard Specification for Ductile Iron Culvert Pipe

ASTM A74	(2013a) Standard Specification for Cast Iron Soil Pipe and Fittings
ASTM A742/A742M	(2013) Standard Specification for Steel Sheet, Metallic Coated and Polymer Precoated for Corrugated Steel Pipe
ASTM A760/A760M	(2010) Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains
ASTM A762/A762M	(2008) Standard Specification for Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains
ASTM A798/A798M	(2013) Standard Practice for Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications
ASTM A807/A807M	(2002; R 2008) Standard Practice for Installing Corrugated Steel Structural Plate Pipe for Sewers and Other Applications
ASTM A849	(2010) Standard Specification for Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe
ASTM A929/A929M	(2001; R 2007) Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
ASTM B26/B26M	(2012) Standard Specification for Aluminum-Alloy Sand Castings
ASTM C1103	(2003; R 2009) Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM C139	(2011) Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes
ASTM C1433	(2013) Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers
ASTM C231/C231M	(2010) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C270	(2012a) Standard Specification for Mortar for Unit Masonry
ASTM C32	(2013) Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale)
ASTM C425	(2004; R 2009) Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C443	(2011) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C478	(2013) Standard Specification for Precast Reinforced Concrete Manhole Sections

ASTM C55	(2011) Concrete Brick
ASTM C564	(2012) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C62	(2013) Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C828	(2011) Low-Pressure Air Test of Vitrified Clay Pipe Lines
ASTM C877	(2008) External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
ASTM C923	(2008; R 2013) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C924	(2002; R 2009) Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
ASTM C990	(2009) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM D1056	(2007) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D1171	(1999; R 2007) Rubber Deterioration - Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)
ASTM D1557	(2012) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D1751	(2004; R 2008) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	(2004a; R 2008) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion
ASTM D1784	(2011) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D2167	(2008) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D2321	(2011) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D2729	(2011) Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings

ASTM D3034	(2008) Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3212	(2007; R 2013) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D3350	(2012) Polyethylene Plastics Pipe and Fittings Materials
ASTM D6938	(2010) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM F1417	(2011a) Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air
ASTM F477	(2010) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F679	(2008) Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
ASTM F714	(2013) Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
ASTM F794	(2003; R 2009) Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F894	(2013) Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
ASTM F949	(2010) Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

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1.3 MEASUREMENT AND PAYMENT

1.3.1 Pipe Culverts and Storm Drains

The length of pipe installed will be measured along the centerlines of the pipe from end to end of pipe without deductions for diameter of manholes. Additional pipe will be paid for at the contract unit price for the number of linear feet of culverts or storm drains placed in the accepted work. Unit price includes all labor, material, appurtenances, pipe bedding, well pointing and sheeting (if necessary), and testing.

1.3.2 Manholes and Inlets

The quantity of manholes and inlets will be measured as the total number of manholes and inlets of the various types of construction, complete with frames and gratings or covers and, where indicated, with fixed side-rail ladders, constructed to the depth indicated.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01300 "Submittals."

1.4.1 Product Data

A. Placing Pipe

Printed copies of the manufacturer's recommendations for installation procedures of the material being placed, prior to installation.

B. Frame and Cover for Structures

1.4.2 Certificates

A. Pipeline Testing

B. Hydrostatic Test on Watertight Joints

C. Determination of Density

D. Frame and Cover for Structures

Certified copies of test reports demonstrating conformance to applicable pipe specifications, before pipe is installed. Certification on the ability of frame and cover or gratings to carry the imposed live load.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Owner. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install plastic pipe shall be stored in accordance with the manufacturer's recommendations and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.5.2 Handling

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

PART 2 - PRODUCTS

2.1 PIPE FOR CULVERTS AND STORM DRAINS

Pipe for culverts and storm drains shall be of the sizes indicated and shall conform to the requirements specified.

2.1.1 Concrete Pipe

ASTM C 76, Class V.

2.1.2 Fully Bituminous Coated Steel Pipe

AASHTO M 190 Type A and ASTM A760/A760M zinc or aluminum (Type 2) coated pipe of either:

a. Type I or II pipe with 2-2/3 by 1/2 inch corrugations.

2.1.3 Ductile Iron Culvert Pipe

ASTM A716.

2.1.4 Polyethylene (PE) Pipe

Submit the pipe manufacturer's resin certification, indicating the cell classification of PE used to manufacture the pipe, prior to installation of the pipe. The minimum cell classification for polyethylene plastic shall apply to each of the seven primary properties of the cell classification limits in accordance with ASTM D3350.

2.1.4.1 Smooth Wall PE Pipe

ASTM F714, maximum DR of 21 for pipes 3 to 24 inches in diameter and maximum DR of 26 for pipes 26 to 48 inches in diameter. Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D3350, minimum cell class 335434C.

2.1.4.2 Corrugated PE Pipe

AASHTO M 294, Type S or C. For slow crack growth resistance, acceptance of resins shall be determined by using the notched constant ligament-stress (NCLS) test meeting the requirements of AASHTO M 294. Pipe walls shall have the following properties:

Nominal Size (mm) (inch))	Minimum Wall Area (square mm/m) (square in/ft)	Minimum Moment of Inertia of Wall Section (mm to the 4th/mm) (in. to the 4th/in.)
30012	32001.5	3900.024
37515	40001.91	8700.053
45018	49002.34	10200.062
60024	66003.14	19000.116
75030	83003.92	26700.163
90036	95004.50	36400.222
105042	99004.69	89000.543
120048	10,9005.15	89000.543
135054	12,0005.67	13,1100.800
150060	13,6506.45	13,1100.800

2.2 DRAINAGE STRUCTURES

2.2.1 Precast Reinforced Concrete Box

Boxes subjected to highway and container handling vehicle loadings shall conform to ASTM C 789 and the Contract Drawings.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Concrete

Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for 5000 psi concrete under Section 03 30 00 “Cast-in-Place Concrete.” The concrete mixture shall have air content by volume of concrete, based on measurements made immediately after discharge from the mixer, of 5 to 7 percent when maximum size of coarse aggregate exceeds 1-1/2 inches. Air content shall be determined in accordance with ASTM C 231. Concrete covering deposited directly against the ground shall have a thickness of at least 3 inches between steel and ground. Expansion-joint filler material shall conform to ASTM D 1751, or ASTM D 1752, or shall be resin-impregnated fiberboard conforming to the physical requirements of ASTM D 1752.

2.3.2 Mortar

Mortar for pipe joints, connections to other drainage structures, and brick or block construction shall conform to ASTM C 270, Type M, except that the maximum placement time shall be 1 hour. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar. Water shall be clean and free of harmful acids, alkalis, and organic impurities. The mortar shall be used within 30 minutes after the ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. The mortar head on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

2.3.3 Precast Concrete Segmental Blocks

Precast concrete segmental block shall conform to ASTM C 139, not more than 8 inches thick, not less than 8 inches long, and of such shape that joints can be sealed effectively and bonded with cement mortar.

2.3.4 Brick

Brick shall conform to ASTM C 62, Grade SW; ASTM C 55, Grade S-I or S-II; or ASTM C 32, Grade MS. Mortar for jointing and plastering shall consist of one part Portland cement and two parts fine sand. Lime may be added to the mortar in a quantity not more than 25 percent of the volume of cement. The joints shall be filled completely and shall be smooth and free from surplus mortar on the inside of the structure. Brick structures shall be plastered with 1/2 inch of mortar over the entire outside surface of the walls. For square or rectangular structures, brick shall be laid in stretcher courses with a header course every sixth course. For round structures, brick shall be laid radially with every sixth course a stretcher course.

2.3.5 Precast Reinforced Concrete Manholes and Inlets

Precast reinforced concrete manholes shall conform to ASTM C 478. Joints between precast concrete risers and tops shall be made with flexible watertight, rubber-type gaskets meeting the requirements of paragraph JOINTS.

2.3.6 Frame and Cover for Gratings

Frame shall be cast gray iron, ASTM A 48/A 48M, Class 35B; Grating shall be cast ductile iron, ASTM A 536, Grade 65-45-12. Frame and cover shall be rated to support loads specified on the Contract Drawings.

2.3.7 Joints

2.3.7.1 Flexible Watertight Joints

A. Materials: Flexible watertight joints shall be made with plastic or rubber-type gaskets for concrete pipe and with factory-fabricated resilient materials for clay pipe. The design of joints and the physical requirements for plastic gaskets shall conform to AASHTO M 198, and rubber-type gaskets shall conform to ASTM C 443. Factory-fabricated resilient joint materials shall conform to ASTM C 425. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber-type gasket are permitted if the nominal diameter of the pipe being gasketed exceeds 54 inches.

B. Test Requirements: Watertight joints shall be tested and shall meet test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS. Rubber gaskets shall comply with the oil resistant gasket requirements of ASTM C 443. Certified copies of test results shall be delivered to the Owner before gaskets or jointing materials are installed. Alternate types of watertight joint may be furnished, if specifically approved.

2.3.7.2 PVC Plastic Pipes

Joints shall be solvent cement or elastomeric gasket type in accordance with the specification for the pipe and as recommended by the pipe manufacturer.

2.3.7.2.1 Corrugated PE Plastic Pipe

Pipe joints shall be watertight and shall conform to the requirements in AASHTO M 294. Water tight joints shall be made using a PE coupling and rubber gaskets as recommended by the pipe manufacturer. Rubber gaskets shall conform to ASTM F477.

2.3.7.3 External Sealing Bands

Requirements for external sealing bands shall conform to ASTM C 877.

2.3.7.3 Ductile Iron Pipe

Couplings and fittings shall be as recommended by the pipe manufacturer.

2.4 STEEL LADDER

Steel ladder shall be provided where the depth of the manhole exceeds 12 feet. These ladders shall be not less than 16 inches in width, with 3/4 inch diameter rungs spaced 12 inches apart. The two stringers shall be a minimum 3/8 inch thick and 2-1/2 inches wide. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A 123/A 123M.

2.5 RESILIENT CONNECTORS

Flexible, watertight connectors used for connecting pipe to manholes and inlets shall conform to ASTM C 923.

2.6 Hydrostatic Tests on Watertight Joints

2.6.1 Concrete, Clay, PVC, PE and PP Pipe

A hydrostatic test shall be made on the watertight joint types as proposed. Only one sample joint of each type needs testing; however, if the sample joint fails because of faulty design or workmanship, an additional sample joint may be tested. During the test period, gaskets or other jointing material shall be protected from extreme temperatures which might adversely affect the performance of such materials. Performance requirements for joints in reinforced and nonreinforced concrete pipe shall conform to ASTM C990 or ASTM C443. Test requirements for joints in clay pipe shall conform to ASTM C425. Test requirements for joints in PVC, PE, and PP plastic pipe shall conform to ASTM D3212.

2.7.2 Corrugated Steel and Aluminum Pipe

A hydrostatic test shall be made on the watertight joint system or coupling band type proposed. The moment strength required of the joint is expressed as 15 percent of the calculated moment capacity of the pipe on a transverse section remote from the joint by the AASHTO HB-17 (Division II, Section 26). The pipe shall be supported for the hydrostatic test with the joint located at the point which develops 15 percent of the moment capacity of the pipe based on the allowable span in feet for the pipe flowing full or 40,000 foot-pounds, whichever is less. Performance requirements shall be met at an internal hydrostatic pressure of 10 psi, for a 10 minute period for both annular corrugated metal pipe and helical corrugated metal pipe with factory reformed ends.

PART 3 - EXECUTION

3.1 EXCAVATION FOR PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES

Excavation of trenches, and for appurtenances and backfilling for culverts and storm drains, shall be in accordance with the applicable portions of Section 31 00 00 “Earthwork” and the requirements specified below.

3.1.1 Trenching

The width of trenches at any point below the top of the pipe shall be not greater than the outside diameter of the pipe plus 12 inches to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheeting and bracing, where required, shall be placed within the trench width as specified. Contractor shall not over excavate.

3.1.2 Removal of Rock

Rock in either ledge or boulder formation shall be replaced with suitable materials to provide a compacted earth cushion having a thickness between unremoved rock and the pipe of at least 12 inches. Where bell-and-spigot pipe is used, the cushion shall be maintained under the bell as well as under the straight portion of the pipe. Rock excavation shall be as specified and defined in Section 31 00 00 “Earthwork.”

3.1.3 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material, compacted as provided in paragraph BACKFILLING. When removal of unstable material is due to the fault or neglect of the Contractor

while performing shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the Owner.

3.2 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe. Refer to construction drawings for pipe bedding details.

3.2.1 Concrete Pipe Requirements

Concrete pipe shall be bedded in a soil foundation accurately shaped and rounded to conform to the lowest one-fourth of the outside portion of circular pipe or to the lower curved portion of pipe arch for the entire length of the pipe or pipe arch. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall be not more than the length, depth, and width required for properly making the particular type of joint.

3.2.2 Corrugated Metal Pipe

Bedding for corrugated metal pipe and pipe arch shall be in accordance with ASTM A798/A798M. It is not required to shape the bedding to the pipe geometry. However, for pipe arches, either shape the bedding to the relatively flat bottom arc or fine grade the foundation to a shallow v-shape. Bedding for corrugated structural plate pipe shall meet requirements of ASTM A807/A807M.

3.2.3 Ductile Iron and Cast-Iron Pipe

Bedding for ductile iron and cast-iron pipe shall be as shown on the drawings.

3.2.4 Plastic Pipe

Bedding for PVC, PE, and PP pipe shall meet the requirements of ASTM D2321. Use Class IB or II material for bedding, haunching, and initial backfill.

3.3 PLACING PIPE

Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary.

3.3.1 Concrete and Ductile Iron Pipe

Laying shall proceed upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

3.3.2 Corrugated PE and Dual Wall and Triple Wall PP Pipe

Laying shall be with the separate sections joined firmly on a bed shaped to line and grade and shall follow manufacturer's recommendations.

3.3.3 Corrugated Metal Pipe and Pipe Arch

Laying shall be with the separate sections joined firmly together, with the outside laps of circumferential joints pointing upstream, and with longitudinal laps on the sides. Part paved pipe shall be installed so that the centerline of bituminous pavement in the pipe, indicated by suitable markings on the top at each end of the pipe sections, coincides with the specified alignment of pipe. Fully paved steel pipe or pipe arch shall have a painted or otherwise applied label inside the pipe or pipe arch indicating sheet thickness of pipe or pipe arch. Any unprotected metal in the joints shall be coated with bituminous material as specified in AASHTO M 190 or AASHTO M 243. Interior coating shall be protected against damage from insertion or removal of struts or tie wires. Lifting lugs shall be used to facilitate moving pipe without damage to exterior or interior coatings. During transportation and installation, pipe or pipe arch and coupling bands shall be handled with care to preclude damage to the coating, paving or lining. Damaged coatings, pavings and linings shall be repaired in accordance with the manufacturer's recommendations prior to placing backfill. Pipe on which coating, paving or lining has been damaged to such an extent that satisfactory field repairs cannot be made shall be removed and replaced. Vertical elongation, where indicated, shall be accomplished by factory elongation. Suitable markings or properly placed lifting lugs shall be provided to ensure placement of factory elongated pipe in a vertical plane.

3.4 JOINTING

3.4.1 Concrete Pipe

3.4.1.1 Flexible Watertight Joints

Gaskets and jointing materials shall be as recommended by the particular manufacturer in regard to use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Gaskets and jointing materials shall be inspected before installing the pipe; any loose or improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pushed home. If, while the joint is being made the gasket becomes visibly dislocated the pipe shall be removed and the joint remade.

3.4.1.2 External Sealing Band Joint for Noncircular Pipe

Surfaces to receive sealing bands shall be dry and clean. Bands shall be installed in accordance with manufacturer's recommendations.

3.4.2 Corrugated Metal Pipe

3.4.2.1 Field Joints

Transverse field joints shall be designed so that the successive connection of pipe sections will form a continuous line free of appreciable irregularities in the flow line. In addition, the joints shall meet the general performance requirements described in ASTM A798/A798M. Suitable transverse field joints which satisfy the requirements for one or more of the joint performance categories can be obtained with the following types of connecting bands furnished with suitable band-end fastening devices: corrugated bands, bands with projections, flat bands, and bands of special design that engage factory reformed ends of corrugated pipe. The space between the pipe and connecting bands shall be kept free from dirt and grit so that corrugations fit snugly. The connecting band, while being tightened, shall be tapped with a soft-head mallet of wood, rubber or plastic, to take up slack and ensure a tight joint. [The annular space between abutting sections of part paved, and fully paved pipe and pipe arch, in sizes 30 inches or larger, shall be

filled with a bituminous material after jointing.] Field joints for each type of corrugated metal pipe shall maintain pipe alignment during construction and prevent infiltration of fill material during the life of the installations. The type, size, and sheet thickness of the band and the size of angles or lugs and bolts shall be as indicated or where not indicated, shall be as specified in the applicable standards or specifications for the pipe.

3.4.2.2 Flexible Watertight, Gasketed Joints

Installation shall be as recommended by the gasket manufacturer for use of lubricants and cements and other special installation requirements. The gasket shall be placed over one end of a section of pipe for half the width of the gasket. The other half shall be doubled over the end of the same pipe. When the adjoining section of pipe is in place, the doubled-over half of the gasket shall then be rolled over the adjoining section. Any unevenness in overlap shall be corrected so that the gasket covers the end of pipe sections equally. Connecting bands shall be centered over adjoining sections of pipe, and rods or bolts placed in position and nuts tightened. Band Tightening: The band shall be tightened evenly, even tension being kept on the rods or bolts, and the gasket; the gasket shall seat properly in the corrugations. Watertight joints shall remain uncovered for a period of time designated, and before being covered, tightness of the nuts shall be measured with a torque wrench. If the nut has tended to loosen its grip on the bolts or rods, the nut shall be retightened with a torque wrench and remain uncovered until a tight, permanent joint is assured.

3.5 DRAINAGE STRUCTURES

3.5.1 Manholes and Inlets

Construction shall be of reinforced concrete, precast reinforced concrete, or precast concrete segmental blocks; complete with frames and covers or gratings; and with fixed galvanized steel ladders where specified. Pipe connections to concrete manholes and inlets shall be made with flexible, watertight connectors.

3.6 STEEL LADDER INSTALLATION

Ladder shall be adequately anchored to the wall by means of steel inserts spaced not more than 6 feet vertically, and shall be installed to provide at least 6 inches of space between the wall and the rungs. The wall along the line of the ladder shall be vertical for its entire length.

3.7 BACKFILLING

3.7.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 6 inches in compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation of at least 12 inches above the top of the pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 8 inches. Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the Owner, that sheeting or portions of bracing used be left in place, the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

3.7.2 Backfilling Pipe in Fill Sections

For pipe placed in fill sections, backfill material and the placement and compaction procedures shall be as specified below. The fill material shall be uniformly spread in layers longitudinally on both sides of the pipe, not exceeding 6 inches in compacted depth, and shall be compacted by rolling parallel with pipe or by mechanical tamping or ramming. Prior to commencing normal filling operations, the crown width of the fill at a height of 12 inches above the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 12 feet, whichever is less. After the backfill has reached at least 12 inches above the top of the pipe, the remainder of the fill shall be placed and thoroughly compacted in layers not exceeding 8 inches.

3.7.3 Movement of Construction Machinery

When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

3.7.4 Compaction

3.7.4.1 General Requirements

Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils will show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

3.7.4.2 Minimum Density

Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to the following applicable minimum density, which will be determined as specified below.

A. Under pavements including adjacent shoulder areas, the density shall be not less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material, up to the elevation where requirements for pavement subgrade materials and compaction shall control.

B. Under unpaved or turfed traffic areas, density shall not be less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material.

C. Under nontraffic areas, density shall be not less than that of the surrounding material.

3.7.5 Determination of Density

Testing shall be the responsibility of the Contractor and performed at no additional cost to the Owner. Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. Tests shall be performed in sufficient number to ensure that specified density is being obtained. Laboratory tests for moisture-density relations shall be made in accordance with ASTM D 1557 except that mechanical tampers may be used provided the

results are correlated with those obtained with the specified hand tamper. Field density tests shall be determined in accordance with ASTM D 2167 or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted, if necessary, using the sand cone method as described in paragraph Calibration of the referenced publications. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017 or ASTM D 2922. Test results shall be furnished the Owner. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed.

End of Section 33 40 00

33 65 36 - PROTECTIVE COATING FOR EXISTING AND NEW CONCRETE AND MASONRY SANITARY SEWER STRUCTURES

PART 1 – GENERAL

1.01 - GENERAL

A. This specification covers labor, materials, and equipment required for protecting and/or rehabilitating the interior of concrete sanitary sewer structures by application of a coating to protect the concrete structure from hydrogen sulfide and acid generated by microbiological sources present in the municipal wastewater environment. The protective coating shall also eliminate infiltration, repair voids, and enhance the structural integrity of the sanitary sewer structure. Procedures for surface preparation, cleaning, application and testing are described herein.

B. Cementitious material will not be allowed for the protective coating, however, it will be allowed for patching operations.

C. For new sanitary sewer manholes and valve pits: The protective coating shall be an acrylic polymer-base concrete coating and sealant. Procedures for surface preparation and application are described herein.

D. For force main discharge manholes (including the two (2) manholes downstream of the discharge manhole, for a total of three (3) manholes), drop manholes and lift station wetwells: The protective coating shall be a polymer based polyurethane or a high-build, solvent-free epoxy coating. For small lift stations and at the discretion of the City, the number of manholes requiring coating may be reduced.

   For lift station wetwells, the coating limits shall include from the bottom of fillet, wetwell walls, and roof. Coating system shall overlap 1” to 2” where hatches sit on the roof; but shall exclude the wetwell floor. For manholes, the coating limits shall include from the flow line in the trough of the invert up to the ring with a 1” to 2” overlay on the ring.

E. This specification also covers labor, materials, and equipment required for corrosion protection of the ductile iron discharge pipes and fittings within lift station wetwells.

1.02 - REFERENCES

A. ASTM D638 - Tensile Properties of Plastics.

B. ASTM D790 - Flexural Properties of Unreinforced/Reinforced Plastics.

C. ASTM D695 - Compressive Properties of Rigid Plastics.

D. ASTM D4414 - Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gauges

E. ASTM D4541 - Pull-off Strength of Coatings Using a Portable Adhesion Tester.

F. ASTM D2584 - Volatile Matter Content.

G. ASTM D2240 - Durometer Hardness, Type D.

H. ASTM D543 - Resistance of Plastics to Chemical Reagents.

J. ASTM C109 - Compressive Strength Hydraulic Cement Mortars.

K. ACI 506.2-77 - Specifications for Materials, Proportioning, and Application of Shotcrete.

L. ASTM C478 - Bond Strength to Concrete: Concrete Failed.

M. ASTM C496 - Tensile Strength of Chemically Setting Silicate and Silica Chemical Resistant Mortars.

N. ASTM C579 - Compressive Strength of Chemically Setting Silicate and Silica Chemical Resistant Mortars.

O. ASTM - The published standards of the American Society for Testing and Materials, West Conshohocken, PA.

P. NACE - The published standards of National Association of Corrosion Engineers (NACE International), Houston, TX.

Q. SSPC - The published standards of the Society of Protective Coatings, Pittsburgh, PA.

R. ASTM C396 - Compressive Strength of Cement Mortars.

S. ASTM C580 - Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concrete.

T. ASTM D4541 - Standard Test Method for Drying Shrinkage of Mortar Containing Hydraulic Cement.

U. ASTM D4787 - Standard Practice for Continuity Verification of Liquid or Sheet Depth Applied to Concrete Substrates.

1.03 - SUBMITTALS

A. Product Data:

1. Technical data sheet on each product used, including ASTM test results indicating the product conforms to and is suitable for its intended use per these specifications.

2. Material Safety Data Sheets (MSDS) for each product used.

3. Project specific guidelines and recommendations.

4. Warranty Certificate in accordance with Part 1.08 of this Section.

5. For Lift Station Wetwells:

   a. Provide reference documentation to confirm that the proposed coating system has a proven record of performance when used in the intended application, including a list of at least five (5) successful installations that have been in service for a period of ten (10) years. The reference list shall include the name of the facility, the application date, a contact person, and a telephone number.

   b. Applicator Qualifications:

      1) Manufacturer certification that Applicator has been trained and approved in the handling, mixing and application of the products to be used.

      2) Certification that the equipment to be used for applying the products has been manufactured or approved by the concrete rehabilitation products manufacturer, protective coating manufacturer, and certified for proper use for this specific application.

      3) Written documentation of four (4) recent references of Applicator (involving wetwells with surface area of approximately 3,000 square feet) indicating successful application of a polyurethane or a high-build solvent-free epoxy coating.

      4) Applicator must provide written documentation of having installed a minimum of 40,000 square feet of protective coating similar to that specified within the last two (2) years.

5) Any project specific guidelines for the project.

6) Design details for any additional ancillary systems and equipment to be used in site and surfaced preparation, application and testing.

1.04 - QUALITY ASSURANCE

A. Applicator shall initiate and enforce quality control procedures consistent with applicable ASTM, NACE and SSPC standards and the protective coating manufacturer's recommendations.

B. Coating Manufacturer's authorized field representative shall be on site prior to the application of the coating system to verify that the substrate has been properly prepared, and during the application of the coating system to certify that the coating system has been properly applied. The authorized field representative will provide the Owner with an accurate and objective written report stating inspection observations on the preparation, application, and final inspection verifying adherence to coating manufacturer recommendations, industry standards, and the written specifications.

1.05 - DELIVERY, STORAGE, AND HANDLING

A. All materials are to be kept dry, protected from weather and stored under cover.

B. Protective coating materials are to be stored according to manufacturer's recommendations. Do not store near flame, heat or strong oxidants.

C. Repair and protective coating materials are to be handled according to their material safety data sheets.

1.06 - SITE CONDITIONS

A. Applicator shall conform with all local, state and federal regulations including those set forth by OSHA, RCRA and the EPA and any other applicable authorities.

B. Method statements and design procedures are to be provided by the Contractor when confined space entry is required.

C. During coating operations of existing manholes and lift station wetwells, Contractor shall provide temporary flow bypassing of the structure if required by the City.

1.07 - ACCESS TO THE WORK SITE

A. Contractor shall provide proper facilities for such access and observation of the Work and also for any inspection or testing by others. If any Work is covered contrary to the request of the City of Savannah (COS) Representative, it must, if requested by the COS Representative, be uncovered for observation and replaced at the Contractor's expense.

B. Contractor shall provide access to site inspection.

1.08 - WARRANTY

A. Sanitary Sewer Manholes and Valve Pits:

All materials and workmanship shall be warranted to the owner for a period of five (5) years.

B. Force Main Discharge Manholes, Drop Manholes and Lift Station Wetwells:

1. Materials

The top coat manufacturer shall warrant the manufacturer's materials used on wastewater structures against failure of the system resulting in biogenic corrosion caused by exposure to sanitary sewer environment for the period of ten (10) years from the date of certified inspection and acceptance by the Owner. Within sixty (60) days of receiving written notice from the Owner, the manufacturer shall replace any defective product and the approved application contractor shall repair defects in materials and/or workmanship which may develop during the warranty period.

2. Application

The applicator shall warrant that all coating work performed shall be free of significant defects in materials and/or workmanship for a period of ten (10) years from the date of certified inspection and final acceptance by the Owner. Applicator shall remove, replace, or repair as he/she deems appropriate, such defective work.

3. Bypassing

In the event of liner failure, the City of Savannah Conveyance Department shall assist application contractor make the necessary repairs by bypassing the structures to be repaired. The City shall not bear any additional costs of coating repairs, such

as dewatering and cleaning structures, providing coating underlayment or top coat materials, or applying the coating system.

PART 2 - PRODUCTS

2.01 - REPAIR MATERIALS

A. Cementitious patching, repair, and structural restoration materials used shall be only those specified and pre-approved. Project specific submittals shall be provided including application, cure time and surface preparation procedures which permit optimum bond strength with protective coating.

B. Repair materials shall be used to fill voids, structurally reinforce and/or rebuild substrate surfaces, etc. as determined necessary by the engineer and protective coating applicator. Quick blending, rapid setting, high early strength, fiber reinforced, non-shrink repair mortar that can be trowelled or pneumatically spray applied must be compatible with the specified protective coating and shall be applied in accordance with the manufacturer's recommendations.

C. The following products are accepted and approved as compatible repair basecoat materials for protective topcoating for use within the specifications.

1. Infiltration Control

   All fast setting materials furnished shall be applied directly to active leaks under hydrostatic pressure from the exterior of the concrete in wetwell structures or control by dewatering methods. Materials shall consist of rapid setting cements and various accelerating agents. Material shall not contain chlorides, gypsum, or metallic particles.

   Should groundwater be encountered, Contractor shall be responsible for utilizing a dewatering system(s) to remove water from the excavations.

2. Repair, patching, and structural restoration

   All material furnished shall be designed to fill voids and to repair or reconstruct where no hydrostatic pressure exists. Material shall consist of rapid setting cements, NSG aggregates, and various accelerating agents. Material shall not contain chlorides, gypsum, or metallic particles.

All structural restoration materials shall be specifically designed for the rehabilitation of wastewater pump station wetwells and other related concrete structures. Materials shall contain poly fiber reinforcement, fused calcium aluminate, and chemical admixtures.

D. Structural Restoration Material Properties:

Product types	Fused Calcium Aluminate Cement OR Underlayment concrete approved by top coat system manufacturer
Cure Time	< 48 hours
Curing gases	Non-toxic
Compressive Strength	5,000 psi
Tensile Strength	500 psi
Flexural Strength	600 psi
Shrinkage	0% at 90% Relative Humidity

2.02 - SANITARY SEWER MANHOLES AND VALVE PITS

A. Interior and Exterior Coating Material

The interior and exterior of all manhole and valve pit structures shall be coated with three coats of a factory or field applied acrylic polymer-base concrete coating and sealant that is neither asphalt nor coal tar based. Acceptable coating is ConSeal CS-55, colors gray or black, as manufactured by Concrete Sealants, New Carlisle, Ohio or equal. The total dry film thickness shall be 3.5 mils. Coating shall be applied to the tongue and groove area of the manhole and valve pit sections as well.

B. The coating manufacturer and applicator shall inspect and certify all coatings prior to the coated pre-cast structures leaving the precast facility.

2.03 - FORCE MAIN DISCHARGE MANHOLES, DROP MANHOLES, AIR RELEASE VALVE MANHOLES & LIFT STATION WETWELLS

A. Structural Restoration & Coating Products:

1. Raven Lining Systems Products
2. Sauereisen Lining Products

3. Spectrashield Liner System Products
4. Or approved equal (2) weeks prior to bid date

B. Protective Coating Material:

Product type	Polyurethane or solid Epoxy
Color	Light
Compressive Strength	15,000 psi
Tensile Strength	1,500 psi
Hardness	Type D 60
Bond Strength – Concrete	> Tensile Strength of Concrete
Dry Film Thickness	125 mils

2.04 - APPLICATION EQUIPMENT

Structural restoration mortars and protective coatings shall be applied with manufacturer approved equipment.

PART 3 - EXECUTION

3.01 - ACCEPTABLE APPLICATORS

A. Repair mortar must be applied by manufacturer trained and approved applicators. The repair mortar shall be applied according to manufacturer's recommendations.

B. Protective coating must be applied by a Certified Applicator of the protective coating manufacturer and according to manufacturer specifications.

3.02 - EXAMINATION

A. Appropriate actions shall be taken to comply with local, state and federal regulatory and other applicable agencies with regard to environment, health and safety.

B. All bidders are required to verify that they have visited the jobsite, and are familiar with the conditions and the entire scope of work. Bidders shall field verify the attached plans and perform their own quantity measurements prior to bidding.

C. Contractor shall provide a minimum 24 hour notice to the COS Inspector / Representative for the following conditions:

1. After final surface preparation is completed but before structure rehabilitation;
2. After patching operations have cured, and
3. After each coating layer is applied.

D. Installation of the protective coating shall not commence until the concrete substrate has properly cured in accordance with these specifications.

E. Temperature of the surface to be coated should be maintained between 60° F and 100° F during application. Prior to and during application, care should be taken to avoid exposure of direct sunlight or other intense heat source to the structure being coated. Where varying surface temperatures do exist, care should be taken to apply the coating when the temperature is falling versus rising (i.e., late afternoon into evening vs. morning into afternoon).

3.03 - SURFACE PREPARATION

A. Applicator shall inspect all surfaces specified to receive a protective coating prior to surface preparation. The existing piping, valves, and appurtenances shall be protected during structural rehabilitation and protective coating application.

The pipes and connectors are to be top coated with 30-50 mils DFT nominal. The pipes and connectors are to be primed by the fabricator with epoxy primer (not cold-tar or asphaltic base) that is compatible with the protective coating. After installation, the pipes are to be pressure washed using at a minimum 5,000 PSI and 4 GPM washer and/or abrasive blast cleaned to an SSPC-SP7 'brush-off' specification as necessary for the window of overcoating of the primer.

Wetwell piping and connectors coated with the Zinc/Epoxy exterior coating system per City of Savannah Section 02554 - "Wastewater Collection System" Part 1.01 D, (Ductile Iron Pipe - Exposed Highly Corrosion Applications), shall not require top coating unless otherwise directed by the Engineer or Owner.

B. All contaminants including: oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants shall be removed.

C. All concrete or mortar that is not sound or has been damaged by chemical exposure shall be removed to a sound concrete surface or replaced.

D. Old concrete must be firm and structurally sound as specified by the Engineer.

E. Surface preparation method(s) should be based upon the conditions of the substrate, service environment and the requirements of the protective coating to be applied.

F. Surfaces to receive protective coating shall be cleaned and abraded to produce a sound surface with adequate profile and porosity to provide a strong bond between the protective coating and the substrate. At a minimum, this will be achieved with a low pressure water cleaning equipment using a 0 degree rotating nozzle at a minimum 3,500 psi and 4 GPM. Other methods such as high pressure water jetting (refer to NACE Standard No. 6 /SSPC-SP 13), abrasive blasting, shot-blasting, grinding, scarifying and/or acid etching may also be used. In addition, detergent water cleaning and hot water blasting may be necessary to remove oils, grease or other hydrocarbon residues from the concrete. The method(s) used shall be performed in a manner that provides a uniform, sound clean, neutralized surface that is not excessively damaged.

3.04 - APPLICATION OF REPAIR MATERIALS

A. Areas where structural steel has been exposed or removed shall be repaired in accordance with the Project Engineer's recommendations.

B. Repair/Structural Restoration materials shall meet the specifications here and as described in part 2.01 A of these specifications. The materials shall be applied utilizing proper equipment on to specified surfaces. The structural restoration material shall match the original undamaged surface.

C. Infiltration shall be stopped by using a material which is compatible with the specified repair mortar, waterproof quick setting mortar-type that is suitable for topcoating with the specified protective coating. Contractor shall completely identify the types of grout, mortar, and sealant for repair of leak defects and provide case histories of successful use.

D. Infiltration areas that require crack injection shall be covered in this scope of work. Injection holes shall be drilled through the wetwell at 120° angles from each other at the same plane of elevation. Rows shall be separated no more than three vertical feet, and the holes shall be staggered with the holes in the rows above and below. Provide additional injection holes near observed defects and pipe seals. A minimum of 6 injection holes shall be provided per defect.

Grout shall be injected through holes under pressure with a suitable probe. Injection pressure shall not cause damage to the wetwell structure or surrounding surface

features. Grout shall be injected through the lowest holes first. Grouting from the ground surface will not be allowed. Provide additional injection holes if necessary to ensure grout travel, verified by field observation of grout at adjacent defects or holes. Patch injection holes using a waterproof quick setting mortar after cleaning with a drill.

E. The approved repair materials shall provide a smooth surface with an average profile equivalent to coarse sandpaper to optimally receive the protective coating. No bug-holes or honeycomb surfaces should remain after the final trowel procedure of the repair mortar.

F. The repair materials shall be permitted to cure according to manufacturer recommendations. Curing compounds should not be used unless approved for compatibility with the specified protective coating.

G. After required cleaning and repair is performed, all surfaces shall be inspected for remaining laitance prior to protective coating application. Any evidence of remaining contamination or laitance shall be removed by additional abrasive blast, shot-blast or other approved method. If repair materials are used, refer to these specifications for surface preparation. Areas to be coated must also be prepared in accordance with these specifications after receiving a repair mortar and prior to application of the protective coating.

3.05 - APPLICATION OF PROTECTIVE COATING

A. Application procedures shall conform to the recommendations of the protective coating manufacturer, including material handling, mixing, environmental controls during application, safety, and spray equipment.

B. The equipment shall be specifically designed to accurately ratio and apply the specified protective coating materials and shall be regularly maintained and in proper working order.

C. The protective coating material must be applied by an applicator certified by the protective coating manufacturer.

D. Specified surfaces shall be coated by a moisture tolerant, solvent-free, protective coating properties as described in these specifications.

E. Application equipment approved by the coating manufacturer shall be used to apply each coat of the protective coating.

F. If necessary, subsequent topcoating or additional coats of the protective coating should occur as soon as the basecoat becomes tack free, ideally within 12 hours but no later than the recoat window for the specified products. Additional surface preparation procedures will be required if this recoat window is exceeded.

3.06 - TESTING AND INSPECTION

A. During application a wet film thickness gage meeting ASTM D4414 - Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages, shall be used to ensure a uniform thickness during application.

B. After the protective coating has set hard to the touch it shall be inspected with high-voltage holiday detection equipment meeting ASTM D4787 – Standard Practice for Continuity Verification of Liquid or Sheet Depth Applied to Concrete Substrates. The spark tester shall be initially set at 100 volts per 1 mil (25 microns) of film thickness applied. All detected holidays shall be marked and repaired by abrading the coating surface with grit disk paper or other hand tooling method. After abrading and cleaning, additional protective coating material can be hand applied to the repair area. All touch-up/repair procedures, for areas that do not meet the specified thickness, shall follow the protective coating manufacturer's recommendations.

   An SSPC Certified Coatings Inspector or NACE Certified Coatings Inspector must be present and monitor the holiday testing (and repairs, if necessary). The final inspection report is to include the holiday testing results.

C. A final visual inspection shall be made by the Inspector and manufacturer's representative. Any deficiencies in the finished coating shall be marked and repaired according to the procedures set forth herein by Applicator.

END OF SECTION 33 65 36