

# **PROJECT MANUAL**

## **Fernandina Beach Middle School**

Kitchen/Dining Remodeling and  
Campus Renovations/Enhancements

**NASSAU COUNTY SCHOOL DISTRICT**

BID SET

Volume 2

BHIDE & HALL ARCHITECTS, P. A.  
1329-C KINGSLEY AVENUE  
ORANGE PARK, FLORIDA 32073

B&H PROJECT NO.: 18016

September 25, 2018



# **Fernandina Beach Middle School**

Kitchen/Dining Remodeling and  
Campus Renovations/Enhancements

## **NASSAU COUNTY SCHOOL DISTRICT**

### **BID SET**

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BHA No.18016

September 25, 2018



**SECTION 00 01 01**

**PROJECT TITLE PAGE**

**PROJECT MANUAL – BID SET - CONSTRUCTION DOCUMENTS**

Fernandina Beach Middle School  
315 Citrona Drive  
Fernandina Beach, FL 32034

Fernandina Beach Middle School Kitchen / Dining Remodeling and Campus  
Renovations/Enhancements

**FOR**

**NASSAU COUNTY SCHOOL BOARD**

**NCSB PROJECT NO. 98110-031**

**September 25, 2018**

**Bhide & Hall Architects, P.A.**  
**1329-C Kingsley Avenue**  
**Orange Park, FL 32073**



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### WET-PIPE FIRE SUPPRESSION SPRINKLERS

#### PART 1 GENERAL

##### 1.1 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 SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1015 (1999) Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies

#### AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C651 (1999) Disinfecting Water Mains

#### FM GLOBAL (FM)

FM P7825 (2003) Approval Guide

#### FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR List List of Approved Backflow Prevention Assemblies  
(continuously updated)

#### MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58 (2002) Pipe Hangers and Supports - Materials, Design and Manufacture

#### NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13 **(2010)** ~~(2002)~~ Installation of Sprinkler Systems

NFPA 24 **(2010)** ~~(2002)~~ Installation of Private Fire Service Mains and Their Appurtenances

NFPA 70 **(2011)** ~~(2005)~~ National Electrical Code

#### UNDERWRITERS LABORATORIES (UL)

UL 262 (2004) Gate Valves for Fire-Protection Service

UL Fire Prot Dir **(2010)** ~~(2004)~~ Fire Protection Equipment Directory

## 1.2 SYSTEM DESCRIPTION

- A. Design and provide new automatic wet pipe fire extinguishing sprinkler systems for complete fire protection coverage throughout all areas.

## 1.3 SPRINKLER SYSTEM DESIGN

- A. Design automatic wet pipe fire extinguishing sprinkler systems in accordance with the required and advisory provisions of NFPA 13, except as modified herein, by for light or ordinary hazard occupancy and hydraulic calculations for uniform distribution of water over the design area. Discharge from individual heads in the hydraulically most remote area shall be between 100 percent and 120 percent of the specified density. Each system shall include materials, accessories, and equipment inside and outside the building to provide each system complete and ready for use. Design and provide each system to give full consideration to blind spaces, piping, electrical equipment, ducts, and other construction and equipment in accordance with detailed working drawings to be submitted for approval. Locate sprinkler heads in a consistent pattern and center of ceiling panels both ways with ceiling grid, lights, and air supply diffusers. Provide sprinkler heads and piping system layout. Devices and equipment for fire protection service shall be UL Fire Prot Dir UL Fire Prot Dir listed or FM P7825 FM P7825 approved for use in wet pipe sprinkler systems. Submit all calculations and final signed and sealed drawings to Engineer for review and approval prior to submission for permitting and to start of work. Engineer of Record shall be Contractor's signing and sealing Professional Engineer.
- B. Location of Sprinkler Heads: Heads in relation to the ceiling and the spacing of sprinkler heads shall not exceed that permitted by NFPA 13 for light and ordinary hazard occupancy. Uniformly space sprinklers on the branch piping. Locate heads in center **1/3** of tiles in two directions.
- C. Water Distribution: Distribution shall be uniform throughout the area in which the sprinkler heads will open. Discharge from individual heads in the hydraulically most remote area shall be 100 percent of the specified density.
- D. Density of Application of Water: Size pipe to provide the specified density when the system is discharging the specified total maximum required flow. Application to horizontal surfaces below the sprinklers shall be 0.10 gpm per sq ft (Light Hazard and Ordinary Group I) and .15 gpm per sq foot for Ordinary Hazard.
- E. Sprinkler Discharge Area: Area shall be the hydraulically most remote 1500 sq ft area as defined in NFPA 13.
- F. Outside Hose Allowances: Hydraulic calculations shall include an allowance of 250 gpm for outside hose streams per riser.
- G. Friction Losses: Calculate losses in piping in accordance with the Hazen-Williams formula with 'C' value of 120 for steel piping, 150 for copper tubing, and 140 for cement-lined ductile-iron piping.
- H. Water Supply: Base hydraulic calculations on flow test. Refer to site plan for specific site data.
- I. Detail Drawings: Prepare 24 by 36 inch detail working drawings of sprinkler heads and piping system layout in accordance with NFPA 13, "Working Drawings (Plans)." Show data essential for

proper installation of each system. Show details, plan view, elevations, and sections of the systems supply and piping. Show piping schematic of systems supply, devices, valves, pipe, and fittings. Show point to point electrical wiring diagrams. Submit drawings signed by a registered fire protection engineer.

- J. As-Built Drawings: After completion, but before final acceptance, submit complete set of as-built drawings of each system for record purposes. Submit 24 by 36 inch drawings on reproducible bond or vellum with title block similar to full size contract drawings. Furnish the as-built (record) working drawings in addition to as-built contract drawings required by Division 01, "General Requirements."

#### 1.4 SUBMITTALS

- A. Engineer's approval is required for all submittals; submittals not having an "E" designation are for information only. When used, a designation following the "E" designation identifies the office that will review the submittal. All submittals are to be reviewed by Project Mechanical and Electrical Engineer.
- B. SD-02 Shop Drawings
  - 1. Sprinkler heads and piping system layout
  - 2. Electrical Wiring Diagrams
- C. SD-03 Product Data
  - 1. Piping; E
  - 2. Alarm Valves
  - 3. Valves, including gate, check, and globe
  - 4. Sprinkler heads; E
  - 5. Pipe hangers and supports
  - 6. Pressure or flow switch
  - 7. Fire department connections
  - 8. Mechanical couplings
  - 9. Backflow preventer
  - 10. Annotate descriptive data to show the specific model, type, and size of each item.
- D. SD-05 Design Data
  - 1. Sprinkler system design
  - 2. Submit computer program generated hydraulic calculations to substantiate compliance with hydraulic design requirements. Submit name of software program used.
- E. SD-06 Test Reports: Preliminary tests on piping system.
- F. SD-07 Certificates: Qualifications of installer
- G. SD-10 Operation and Maintenance Data
  - 1. Alarm Valves, Data Package 3
  - 2. Backflow Preventer, Data Package 3
  - 3. Submit in accordance with Section 01700 Execution Requirements, Operation and Maintenance Data.
- H. SD-11 Closeout Submittals: As-built drawings of each system.

## 1.5 QUALITY ASSURANCE

- A. Prior to installation, submit data showing that the Contractor has successfully installed systems of the same type and design as specified herein, or that Contractor has a firm contractual agreement with a subcontractor having such required experience. Data shall include names and locations of at least two installations where the Contractor or the subcontractor referred to above, has installed such systems. Indicate type and design of each system and certify that each system has performed satisfactorily in the manner intended for not less than 18 months.
- B. Qualifications of System Technician: Installation drawings, shop drawing and as-built drawings shall be prepared, by or under the supervision of, an individual who is experienced with the types of works specified herein, and is currently certified by the National Institute for Certification in Engineering Technologies (NICET) as an engineering technician with minimum Level-III certification in Automatic Sprinkler System program. Contractor shall submit data for approval showing the name and certification of all involved individuals with such qualifications at or prior to submittal of drawings.

## 2 PART PRODUCTS

### 2.1 ABOVEGROUND SYSTEMS

- A. Provide fittings for changes in direction of piping and for connections. Make changes in piping sizes through tapered reducing pipe fittings; bushings will not be permitted. Perform welding in the shop; field welding will be permitted. Conceal piping in areas with suspended ceiling and all areas where physically possible. UL poly plastic piping and fittings are approved for this project after a steel pipe riser assembly.
- B. Sprinkler Piping: NFPA 13, except as modified herein. Steel piping shall be Schedule 10 minimum to 40 for sizes less than 8 inches. Fittings into which sprinkler heads, sprinkler head riser nipples, or drop nipples shall be threaded, polypropylene piping or grooved-end type piping is acceptable. Plain-end fittings with and fittings which use steel gripping devices to bite into the pipe when pressure is applied will not be permitted. Rubber gasketed grooved-end pipe and fittings with mechanical couplings shall be permitted in pipe sizes 1.5 inches and larger. Fittings shall be UL Fire Prot Dir listed or FM P7825 approved for use in wet pipe sprinkler systems. Fittings, mechanical couplings, and rubber gaskets shall be supplied by the same manufacturer. Steel piping with wall thickness less than Schedule 30 shall not be threaded. Side outlet tees using rubber gasketed fittings will not be permitted. Sprinkler pipe and fittings shall be metal in metal systems. Flex piping may be used to locate sprinkler heads.
- C. Sprinkler Heads: Provide nominal 0.50 inch or 0.75 inch orifice sprinkler heads. O-rings will not be permitted in sprinkler heads. Release element of each head shall be of the intermediate temperature rating or higher as suitable for the specific application. Provide polished stainless steel ceiling plates or standard chromium-plated finish ceiling plates, and chromium-plated pendent sprinklers below suspended ceilings. Provide corrosion-resistant sprinkler heads and sprinkler head guards in all Storage, Mechanical and Closets or areas subject to damage. Deflector shall not be more than 3 inches below suspended ceilings. Ceiling plates shall not be more than 0.5 inch deep. Ceiling cups shall not be permitted. Provide semi-recessed heads in all classroom and administrative spaces. Fully recessed in all corridors and Locker Room ceiling. See plans for specifics.

- D. Cabinet: Provide metal cabinet with extra sprinkler heads and sprinkler head wrench adjacent to each riser alarm valve. The number and types of extra sprinkler heads shall be as specified in NFPA 13.
- E. Alarm Valves: Provide variable pressure type alarm valve complete with retarding chamber, alarm test valve, alarm shutoff valve, drain valve, pressure gages, accessories, and appurtenances for the proper operation of the system. A riser check assembly may be used.
- F. Pressure or Flow Switch: Provide sprinkler zone switch with circuit opener or closer for the automatic transmittal of an alarm over the facility fire alarm system.
- G. Pipe Hangers and Supports: Provide in accordance with NFPA 13. Attach to steel joists with, Type 19 or 23 clamps and retaining straps. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel and wood with drilled hole on centerline and double nut and washer. Attach to concrete with Type 18 insert or drilled expansion anchor.
- H. Valves: NFPA 13. Provide valves of types approved for fire service. Gate valves shall open by counterclockwise rotation. Provide an OS&Y valve beneath each alarm. Check valves shall be flanged clear opening swing-check type with flanged inspection and access cover plate for sizes 4 inches and larger. Provide double check valve assembly type backflow preventer with OS&Y gate valves on both ends. Each check valve shall have a drain. Each OS&Y gate valve shall be supervised; minimum contact ratings shall be 2.5 amps at 24 volt DC. Provide supervision against valve closure or tampering of valve. Double check valve assembly shall be tested and certified under ASSE 1015.
- I. Backflow Preventer: See Civil for type required. Provide assembly backflow preventer with OS&Y gate valve on both ends. Each check valve shall have a drain. Backflow prevention assemblies shall have current "Certificate of Approval from the Foundation for Cross-Connection Control and Hydraulic Research, FCCCHR List. Listing of the specific make, model, design, and size in the FCCCHR List shall be acceptable as the required documentation." Backflow preventer shall be insulated with 3 inch fiberglass with foil backing, 3/4 lb. density, and housed in a full aluminum jacket insulation enclosure on a 4 inch concrete pad. See Civil plans for details. Provide detector assembly on back flow for connection to existing Fire Alarm. Electrical contractor to provide connection to Fire Alarm System. No heat tracer tape required.
- J. Identification Signs: NFPA 13. Attach properly lettered and approved metal signs to each valve and alarm device. Permanently affix hydraulic design data nameplates to the riser of each system.
- K. Test Connections
1. Inspector's Test Connection for sprinkler Systems: Provide test connections approximately 6 feet above the floor for each sprinkler system or portion of each sprinkler system equipped with an alarm device; locate at the hydraulically most remote part of each system. Provide test connection piping to a drain location that can accept full flow where the discharge will be readily visible and where water may be discharged without property damage. Discharge to a floor drain shall be permitted only if the drain is sized to accommodate full flow. Discharge to janitor sinks or similar fixtures shall not be permitted. Provide discharge orifice of same size as corresponding sprinkler orifice. The penetration of the exterior wall shall be no greater than 2 feet above finished grade.

2. Backflow Preventer Test Connection: Provide downstream of the backflow prevention assembly listed hose valves with 2.5 inch National Standard male hose threads with cap and chain. Provide one valve for each 250 gpm of system demand or fraction thereof. Provide a permanent sign in accordance with paragraph entitled "Identification Signs" which reads, "Test Valve."
- L. Main Drains: Provide separate drain piping to discharge at safe points outside each riser in building. Provide auxiliary drains as required by NFPA 13. Provide precast concrete splash block under each exterior drain discharge. The penetration of the exterior wall shall be no greater than 2 feet above finished grade. Main drain shall also serve as the backflow preventer test connection. Site main drain pipe and valve to support flow at system demand.
- M. Fire Department Connections: Provide 4 inch connections approximately 3 feet above finish grade, of the approved two-way type with 2.5 inch National Standard female hose threads with plug, chain, and identifying fire department connection escutcheon plate.
- N. Alarm Bells: Provide gong (water operated) alarm type compatible with Fire Alarm and Sprinkler Controls. Tie to building Fire Alarm system.

## 2.2 BURIED WATER PIPING SYSTEMS

- A. Pipe and Fittings: Provide outside-coated, cement-mortar lined, ductile-iron pipe, or DR18 PVC and fittings conforming to NFPA 24 for piping and outside of building walls. Anchor joints in accordance with NFPA 24. Provide concrete thrust block at the elbow where the pipe turns up toward the floor, and restrain the pipe riser with steel rods from the elbow to the flange above the floor. Minimum pipe size shall be 6 inches. Minimum depth of cover shall be 3 feet at finish grade. Turn piping up at building and penetrate through building wall. Do not undermine building footing or slab.
- B. Valves: Provide as required by NFPA 24. Gate valves shall conform to UL 262 and shall open by counterclockwise rotation.
- C. Buried Utility Warning and Identification Tape: Provide detectable aluminum foil plastic backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping. Tape shall be detectable by an electronic detection instrument. Provide tape in rolls, 3 inches minimum width, color coded for the utility involved with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification shall read "CAUTION BURIED WATER PIPING BELOW" or similar wording. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material.
- D. The contractor installing underground fire protection lines shall be licensed under Chapter 633, F.S. and shall obtain separate permit from the District for this work. This contractor shall provide a Material and Test Certificate or Underground Piping as specified in NFPA 13.



## 2.3 PIPE SLEEVES

- A. Provide where piping passes entirely through walls, floors, and roofs. Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, and roofs. Provide one inch minimum clearance between exterior of piping and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal space at both ends of the sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric seal. In fire walls and fire floors, seal both ends of pipe sleeves or core-drilled holes with UL listed fill, void, or cavity material.
1. Sleeves in Masonry and Concrete Walls, Floors, and Roofs: Provide hot-dip galvanized steel, ductile-iron, or cast-iron sleeves. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in the core-drilled hole are completely grouted smooth.
  2. Sleeves in Other Than Masonry and Concrete Walls, Floors, and Roofs: Provide 26 gage galvanized steel sheet.

## 2.4 ESCUTCHEON PLATES

- A. Provide split hinge metal plates for piping entering walls, floors, and ceilings in exposed spaces. Provide polished stainless steel plates or chromium-plated finish on copper alloy plates in finished spaces. Provide paint finish on metal plates in unfinished spaces.

## 3PART EXECUTION

### 3.1 INSTALLATION

- A. Installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with, except as modified herein. Install piping straight and true to bear evenly on hangers and supports. Do not hang piping from plaster ceilings. Keep the interior and ends of new piping and existing piping affected by Contractor's operations thoroughly cleaned of water and foreign matter. Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter. Inspect piping before placing into position. Provide Teflon pipe thread paste on male threads.
- B. Electrical Work: Electrical work associated with this section shall be under Division 26.
- C. Disinfection: Disinfect the new water piping and existing water piping affected by Contractor's operations in accordance with AWWA C651. Fill piping systems with solution containing minimum of 50 parts per million (ppm) of available chlorine and allow solution to stand for minimum of 24 hours. Flush solution from the systems with domestic water until maximum residual chlorine content is within the range of 0.2 to 0.5 ppm, or the residual chlorine content of domestic water supply.
- D. Connections to Existing Water Supply Systems: Use tapping or drilling machine valve and mechanical joint type sleeves for connections to be made under pressure. Bolt sleeves around the main piping; bolt valve to the branch connection. Open valve, attach drilling machine, make tap, close valve, and remove drilling machine, all without interruption of service. Notify the Engineer in writing at least 15 days prior to connection date; receive approval before any service is interrupted.

Furnish materials required to make connections into existing water supply systems, and perform excavating, backfilling, and other incidental labor as required. Furnish the labor and the tapping or drilling machine for making the actual connections to existing systems.

- E. Buried Piping System: Bury tape with the printed side up at a depth of 12 inches below the top surface of earth or the top surface of the subgrade under pavements. Provide #10 copper locator wire on PVC type underground piping.

### 3.2 FIELD QUALITY CONTROL

- A. Perform test to determine compliance with the specified requirements in the presence of the Engineer. Test, inspect, and approve piping before covering or concealing.
- B. Preliminary Tests: Hydrostatically test each system at 200 psig for a 2 hour period with no leakage or reduction in pressure. Flush piping with potable water in accordance with NFPA 13. Piping above suspended ceilings shall be tested, inspected, and approved before installation of ceilings. Test the alarms and other devices. Test the water flow alarms by flowing water through the inspector's test connection. When tests have been completed and corrections made, submit a signed and dated certificate, similar to that specified in NFPA 13.
- C. Formal Tests and Inspections: Do not submit a request for formal test and inspection until the preliminary test and corrections are completed and approved. Submit a written request for formal inspection at least 15 days prior to inspection date. An experienced technician regularly employed by the system installer shall be present during the inspection. At this inspection, repeat any or all of the required tests as directed. Correct defects in work provided by the Contractor and make additional tests until the systems comply with contract requirements. Furnish appliances, equipment, electricity, instruments, connecting devices, and personnel for the tests.

### 3.3 FIELD PAINTING

- A. Field painting of exposed fire extinguishing piping sprinkler system shall be machine enamel red - two coats.

END OF SECTION

## SECTION 22 25 00

### PLUMBING

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. The work includes the providing of all labor, materials and services necessary to install the indicated systems, complete with hangers, supports, equipment, and connections required to any fixture or equipment indicated or specified.
- B. The work includes, but is not limited to the following:
  - 1. Sanitary waste and vent piping systems.
  - 2. Domestic hot and cold water piping systems.
  - 3. Gas piping systems.

##### 1.2 ALL WORK

- A. Shall be performed by mechanics skilled in the particular class of work and all equipment shall be installed in strict accordance with the manufacturer's recommendations. The work shall be coordinated with other trades and responsibilities established so that the work shall be completed without delays or interference with schedules.

##### 1.3 CUTTING AND PATCHING

- A. Where required, the Contractor shall do the cutting and patching using workmen who are skilled in the trade involved. The completed work shall present a finished workmanlike appearance.

##### 1.4 PIPING AND DRAWINGS

- A. The drawings are diagrammatic and not intended to show in detail all features of the work. The location of all piping shall be coordinated to determine that it clears all openings and structural members, that piping indicated as concealed can be properly concealed in walls or partitions of finished rooms, and that it does not interfere with lights, ductwork, or equipment having fixed locations. Conceal all piping except where otherwise indicated.

##### 1.5 OPENINGS IN EXISTING CONCRETE CONSTRUCTION

- A. Shall be core drilled or cut with masonry saw. Pneumatic Tools will not be permitted. The integrity of the fire rating of walls, ceilings and floors shall be maintained and shall meet Life Safety and local codes.

##### 1.6 ELECTRICAL WORK

- A. In accordance with Division 26. Refer to electrical drawings for electrical characteristics of equipment.

##### 1.7 TRAPS

- A. Each fixture, equipment drain or floor drain shall be separately trapped, unless otherwise indicated or specified.

## 1.8 UNIONS

- A. Install on each side of each valve and connection to equipment.

## 1.9 ESCUTCHEON PLATES

- A. For all piping through walls, floors and ceilings exposed to view. Chromium plated, two piece, hinged, with set screws. To fit around insulation, where present. Deep escutcheon plates shall be provided where pipe sleeves extend above floors.

## 1.10 SHOP DRAWINGS

- A. Shop drawings of each item listed in the "Equipment Schedules" or elsewhere on the drawings and in the specifications. (These shop drawings shall be submitted to the Architect and approved by him before the Contractor may purchase the equipment or materials.) Two sets will be retained for the Architect.
- B. Shop drawings shall be submitted with all equipment items complete at one time. Shop drawings shall be presented in book form in a hard back binder with heavy paper dividers for each paragraph of the specification delineating an item or items of equipment. Dividers shall be provided with substantial staggered index tabs, with each tab numbered with the specification paragraph number for the included item(s) of equipment. In addition, an index listing each tab division with equipment covered shall be provided at the front of the submittal book. Provide a single tab labeled "DWGS" for items of equipment that might be specified on the Drawings. Items presented singly for approval will not be acceptable.
- C. Coordinate the location of floor drains, piping and other pertinent items with the work of other trades. Installation of these items shall be made after receipt of and in accordance with the approved shop drawings.

## 1.11 UNIONS AND FLANGES

- A. Unions and flanges may not, in every case, be shown on the Drawings, but are to be provided where necessary and adjacent to all equipment installed or provided for under this Contract.

## 1.12 GUARANTEE

- A. All equipment, material, accessories and installation shall carry a guarantee against defects for a period of one year from the date of acceptance. Each system as a whole, and in all its parts, shall be guaranteed to function correctly up to the specified capacity. Should a system, or any part thereof, fail to meet the performance requirements, necessary replacements, alterations or repairs shall be made to bring performance up to specified requirements. Building construction finishes damaged or marred shall be restored to the satisfaction of the Owner's representative. All of the above described shall be done without cost to the Owner.

## 2PART 2 - PRODUCTS

### 2.1 GENERAL

- A. All materials shall be new and free from all defects. These specifications list all of the acceptable materials for a given service, one of which shall be used unless otherwise specifically noted in the specifications or on the Drawings.
- B. The quality and weight of materials furnished and installed shall comply with the requirements and specifications of the appropriate standards of the American Society for Testing and Materials, Life Safety Code and the local plumbing code.

### 2.2 PIPE AND FITTINGS

- A. General: All piping shall be run straight, plumb and properly graded in direction indicated on the Drawings. Cut pipe shall be squarely cut and properly reamed to remove all cuttings and burrs before making up the joints. Fittings and nipples shall be of the same materials as the pipe. In cases where it is necessary to joining copper piping to steel equipment or steel piping, install an insulating fitting equal to EPCO dielectric pipe fittings as manufactured by EPCO Sales, Inc., 3204 Sackett Avenue, Cleveland, Ohio.
- B. Cast Iron Soil Pipe (If Used): Cast iron soil and waste pipe and fittings shall be standard weight, coated with coal tar varnish, and shall comply with ASTM A 74 and CISPI Trademark.
- C. Hubless cast iron pipe and fittings (if used) shall be standard weight, coated with coal tar varnish, and shall comply with ASTM A 74 and CISPI Standard 301.
- D. Steel Pipe (If Used): Steel pipe shall be Schedule 40 mild steel, ASTM A 120. Fittings shall be 150 psi screwed malleable iron fittings, ANSI B16.3.
- E. Above Ground Domestic Water Piping: Copper Watertube shall be Type K, hard copper, ASTM B88. Fittings shall be wrought copper, ANSI B16.3, with lead free solder-ASTM approved.
- F. Plastic Pipe and Fittings: Pipe shall be Schedule 40 PVC conforming to ASTM D 1785. Fittings shall be PVC conforming to ASTM D 2466. Solvent cement shall conform to ASTM D 25646.
- G. (CPVC) - Chlorinated Polyvinyl Chloride Pipe - ASTM F 441, shall meet requirements of the NSF Standard 14. Fitting: ASTM F 439, solvent cement socket type.

### 2.3 VALVES

- A. General: Crane valve numbers are specified to establish type and quality. Equivalent valve types by Fairbanks, Hammond or Powell will be considered for approval.
- B. Domestic Water Piping:
  - 1. Ball Valves: Full port ball valves with stainless steel stem and ball with teflon seat and rings.
  - 2. Hose Bibb: Chicago #387 with watts No. 8A backflow preventer. Hose bibb shall be key operated.

3. Exterior valves 1½" and smaller shall be curb-stop type. 2" and larger shall be cast iron resilient wedge type. Wedge shall be totally encapsulated with rubber, non-rising stem with bonnet and o-ring plate fusion bond epoxy coated.
- C. Gas Piping:
1. Ball Valves: 2" IPS and smaller - Crane #2330-TF with teflon seat rings.
  2. Manual Reset Solenoid Valve: ASCO Redhat 2-Way 8015/8025 Series (NEMA 3 - Outside). Coordinate with Electrical for voltage.
- 2.4 FLOOR DRAINS
- A. Furnish with seepage flange in floors where installed with pans or flashings, furnish clamping ring. Locate drains to suit equipment approved for installation. All floor drains shall be provided with automatic trap primer, and install per manufacturer's recommendations. See Drawings for specifications.
- 2.5 CLEANOUTS
- A. Where indicated and at the base of all risers. Additional cleanouts at the Contractor's option for the convenience of testing and erection. Cleanouts installed in floors with waterproof membrane shall be provided with clamping rings. Install cleanout frames and covers to be flush with adjoining architectural finishing material. Clean-outs located outside of the building shall be two-way type. Josam Model Numbers are indicated below. Comparable Model Numbers by Wade or Jay R. Smith will be considered for approval.
- B. Cleanout Plugs: Josam 58540-20.
- C. Cleanouts in Wall: Josam 58790-22.
- D. Cleanouts in Concrete and Terrazzo Floor Finishes: Josam 58410.
- E. Cleanouts in Vinyl Tile Floor Finishes: Josam 56004-2-15.
- F. Carpeted Floor Finishes: Josam 58410-14.
- 2.6 PIPE HANGERS
- A. Hangers shall be of the clevis type, MSS SP-58, type 1.
- 2.7 DOMESTIC WATERS HEATERS
- A. As specified on the Drawings and install as per the manufacturer's recommendations.
- 2.8 PLUMBING FIXTURES
- A. General: All plumbing fixtures shall be "First Quality". All enameled iron fixtures shall have acid resisting white enamel.
1. All fixtures and fittings proposed shall be from one manufacturer and of similar character. Escutcheons, handles, etc., on the different fixtures shall be of the same design. All fixtures and fittings proposed shall be submitted for approval with catalog cuts and full description. All exposed

metal and piping not otherwise specified shall be polished chromium on brass or bronze. All hot and cold water supply to fixtures shall be provided with stops of the loose key type.

- B. Where fixture types refer to those manufactured by Kohler, unless otherwise noted, these numbers are used to indicate type and quality of fixtures desired. Fixtures of equal quality manufactured by American Standard, Briggs or Elger will be considered for approval. See Drawings for specifications. Hanger supports and carriers shall be installed in accordance with manufacturer's recommendations. All wall-hung fixtures located on a stud wall or chased wall shall be provided with floor carriers. Wall-hung fixtures located on a CMU block wall shall be provided with a heavy-duty anchoring plate.

## 2.9 EQUIPMENT FURNISHED BY OTHER SECTIONS

- A. Certain items of equipment, will be furnished as work of other sections and shall be furnished with necessary plumbing services as work of this section, responsibility includes determining the correct roughing location for services and making final connections.
- B. Piping and Valves necessary to supplement those items which are furnished by other sections shall be furnished and installed by this section. Provide shut-off valves on all supply branches to equipment. All piping and valves in finished room normally exposed to view shall be brass, chromium plated, and provided with chromium plated escutcheon plates.

## 2.10 THERMAL INSULATION

- A. General: No insulation shall be installed until the piping systems have been checked and found free of all leaks. Surfaces shall be clean and dry before attempting to apply insulation. Insulation shall be installed by a professional insulation contractor with adequate experience and ability to perform the work. The Contractor shall verify that all materials comply with the specifications.
- B. Domestic Hot Water Piping:
  - 1. Material: Shall be insulated with one-inch thick "Imcolock" or "Arctictherm" polyethylene pipe insulation.
  - 2. Application: Pipe insulation shall be secured in place by applying pressure to the pressure sensitive closure system. Elbows and tees shall be insulated with miter-cut fittings. Valves and other irregular fittings shall be insulated per manufacturer's installation guidelines.
- C. Domestic Cold Water Piping Exposed to Exterior and Horizontal Storm Water Piping (if applicable):
  - 1. Material: Shall be the same material and applied in the same manner as specified above for domestic hot water piping, except the insulation thickness shall be 1/2 inch.
- D. Waste lines from electric water coolers and waste piping exposed, piping in crawl space or in exterior walls shall be insulated with 3/8 inch thick "Imcolock" or "Arctictherm".
- E. Exposed water piping and P-traps serving handicapped lavatories that receive hot water shall be insulated with Truebro Model # 102W insulation kit.

### 3PART 3 EXECUTION

#### 3.1 SOIL, WASTE AND VENT PIPING

- A. Buried Piping: Soil, waste and storm pipe and fittings below the floor slab and to the building 5 foot line shall be of the Schedule 40 PVC plastic and shall be provided with a locator wire #12 gauge installed per manufacturer's recommendations.
- B. Above Grade: Soil, waste and vent piping and fittings shall be Schedule 40 PVC plastic.
- C. Underfloor Conduit: Steel piping 90 degree elbows shall be of the long sweep type.
- D. Waste and vent piping located in a plenum shall be cast-iron.

#### 3.2 DOMESTIC HOT AND COLD WATER PIPING

- A. Pipe shall be Type "K" hard copper with wrought copper fittings. **Vioga Propress fitting shall be an acceptable alternative.** Interior exposed piping shall be painted to match adjacent surfaces.

#### 3.3 GAS PIPING

- A. **See Fuel Gas Piping Section 231000.** ~~Schedule 80 threaded or galvanized welded socket type asphalt coated. Gas piping under floor shall be in steel conduit.~~

#### 3.4 PROTECTIVE COVERING FOR UNDERGROUND STEEL GAS PIPE

- A. Protective covering for underground pipe shall be mechanically applied in a factory or field plant, especially equipped for that purpose except as hereinafter specified. Fittings which cannot be coated and wrapped mechanically shall have protective coating applied by hand, preferably at the plant. Joints shall be coated and wrapped by hand, in a manner, and with materials that will produce a covering or coating equally effective to mechanically applied covering. Pipe covering shall consist of coal-tar enamel, a wrapper of felt and a wrapper of kraft paper or a coat of water-resistance whitewash applied in order named and conforming to AWWA C203 in all respects as to materials, methods of application, tests and handling, except that interior lining will not be required. In lieu of coal-tar and felt wrapping, a shop applied, extruded polyethylene sheath may be used. When extruded polyethylene sheath is used for protective coating, fittings and joints shall be covered in a manner and with the materials recommended by the applier of the sheath.

#### 3.5 CLEANING AND PROTECTION OF PIPE

- A. Before being placed in position, pipe and fittings shall be cleaned carefully. All pipe shall be maintained in a clean condition.

#### 3.6 PIPE IN TRENCHES

- A. Sewer and water piping shall be placed in separate trenches.
- B. Water piping shall be buried at a depth of 6 inches below the frost line or a minimum of 12 inches, whichever is greater.



### 3.7 BELL AND SPIGOT CAST IRON SOIL PIPING (IF USED)

- A. Bell and spigot cast iron soil piping shall be laid with bell ends pointing up-grade. Pipe shall be graded carefully and shall be supported firmly and uniformly at its proper elevation and grade. Adjacent length of pipe shall be adjusted with reference to each other; blocking or wedging between hub and spigot will not be permitted. Spigots shall be adjusted in bells so as to give a uniform space all around. Open ends of pipes shall be closed by a watertight plug at the end of each day's work.

### 3.8 CAULKED AND LEADED JOINTS (IF USED)

- A. Bell and spigot pipe shall have braided or twisted hemp or oakum gaskets of the best commercial grade and shall provide not less than one inch depth for leading. Gaskets shall not project into the bore of the finished joints. After gaskets are placed, the joints shall be cleaned and the remaining space filled at one pouring with lead which shall be caulked in a manner that will assure tight joints with straining the iron of the bells. After caulking, the lead shall be practically flush with face of the bells. The lead shall contain not less than 99.7 percent pure lead.

### 3.9 BAND AND SCREW ASSEMBLIES (IF USED)

- A. Band and screw assemblies used in conjunction with hubless type cast iron soil pipe shall be tightened to 60 inch pounds torque on each band screw with a torque wrench specifically designed for the purpose. Each screw shall be retorqued after not less than 24 hours. The use of screwdrivers or various types of wrenches will not be permitted for this purpose.

### 3.10 INSTALLATION OF SCREW-JOINTED PIPING (IF USED)

- A. All piping shall be cut accurately to measurements established by the Contractor and shall be worked into place without springing or forcing. Proper provision shall be made for the expansion and contraction of all pipe lines. Pipe and fittings shall be free from fins and burrs. Screw joints in water piping shall be made with a lubricant applied on the male threads only. Threads shall be full cut and not more than three threads on the pipe shall remain exposed. All ferrous pipe thread, after being installed and tested, shall be given one coat of red lead and oil paint. Unions and union type connections and shut-off valves shall be provided for all fixtures and equipment ready for disconnection. On ferrous pipe 3 inches in diameter and smaller, unions shall be 150 pound steam working pressure malleable iron ground joint type. On ferrous pipe 4 inches in diameter and larger, unions shall be 125 pound steam-working-pressure forged steel flange type, with gaskets of 1/16 inch thick best quality rubber or cloth inserted rubber. Pipe hung from ceilings shall be supported by heavy adjustable hangers conforming to MSS SP-59 and SP-69. All hangers and collars shall be of sizes suitable for the weight of the pipe. All changes in sizes of pipe shall be made with reducing fittings.

### 3.11 WATER HAMMER ARRESTORS

- A. Water hammer arrestors shall be provided instead of site-fabricated air chambers, and shall be sized as required and installed in accordance with the manufacturer's recommendations and shall conform with Plumbing and Drainage Institute No. PDI-WH-201. Arrestors shall be of the maintenance free (sealed) type.

### 3.12 WATER SYSTEMS

- A. Water systems shall be installed with a fall towards the shut-off valve or the lowest fixture. Branches from hot and cold water lines shall be provided to fixtures, water heating units, and outlets as indicated.

### 3.13 SANITARY SYSTEMS

- A. Sanitary and storm systems shall be provided where applicable, with Y fittings and 1/8 or 1/16 bends or combination Y and 1/8 bends. All fixtures not specified to be provided with traps as integral parts of their outfits and all drains shall have separate traps with cleanouts. Waste and storm lines shall be not less than 2 inches in diameter. All fixtures shall be individually vented, or shall be connected to a vented soil or waste line. Unless indicated otherwise, sanitary piping shall form circuit or loop vent with no dead ends or inverted siphons. Circuit or loop vent lines shall be connected at a height of not less than 12 inches above the fixtures served. Horizontal vents shall slope down to waste or soil branch or stack. Horizontal soil, waste and storm piping, generally, shall be graded 1/8 inch per foot. Vertical stacks shall be extended full size as vents to not less than 12 inches above the roof and shall be placed in position before the roofing is applied. Where practicable, two or more vent lines may be connected and extended as one pipe through the roof. Cleanouts shall be installed at the foot of each soil or waste line, at changes in direction in the lines, and where indicated; however, within the buildings, the distance between cleanouts in horizontal runs shall in no case exceed 50 feet. Cleanouts in floors shall be extended full size to the floor level with outlets fitted with trap screws with countersunk caps. Cleanouts shall be pipe size except no cleanout shall exceed 6 inches in diameter. Vent flashing at the roof shall extend not less than 8 inches from the vent pipe in all directions. Lead flashing shall be turned down into the pipes or hubs.

### 3.14 GAS PIPING SYSTEM

- A. Shall be installed in accordance with the National Fuel Gas Code, Part 1, (NFPA No. 54, dated 2006) by a Contractor duly licensed by the State as a gas installer.

### 3.15 WATER VALVES

- A. Water valves shall be installed in accessible places and shall be located as follows: (1) valve with hose connection on the building side of the main shut-off valve; (2) shut-off valve on each supply to each fixture not provided with compression stop; (3) valves shall be provided on all branches serving more than one fixture. Where valves are located in a non-accessible location, an access panel shall be provided and submitted for approval.

### 3.16 INSTALLATION OF FIXTURES

- A. Connections between water closets and the flanges on soil pipe shall be made gas and water tight with one piece special molded gasket. All bulk material including putty and plastics shall not be used. Floor drains shall be secured to the waterproofing or flashing in a watertight manner. Exact rough-in locations shall be determined from the Architectural Drawings. Contractor shall replace existing watercloset floor flanges when replacing a water closet.

### 3.17 PIPE SLEEVES

- A. Pipe sleeves shall be provided where pipes pass through masonry or concrete walls, floors, roofs and partitions. Sleeves shall be placed during construction of the building and at no time shall jack hammers be used. Sleeves in outside walls below and above grade, or in floor slabs, shall be zinc-coated sheet steel. Space between pipe, tubing or insulation and the sleeve, shall be not less than 1/4 inch. Sleeves shall be held securely in proper position and locations before and during construction. All sleeves shall be of sufficient length to pass through entire thickness of walls, partitions or slabs. Sleeves in floor slabs shall extend 2 inches above the finished floor. Space between the pipe and the sleeve shall be firmly packed with oakum on both ends of the sleeve with insulating cement. Sleeves located in waterproofed construction shall be provided with flange and clamping ring. Sleeves are not required in floor slabs located on grade, except that copper pipe shall not come in contact with concrete. All penetrations through fire rated walls and floors shall be sealed in a manner to maintain the integrity of this fire rating and meet Life Safety Codes.
- B. Provide termite protection in accordance with FBC 1816.2 at all pipe penetrations through slab or grade floors. Provide rodent proofing in accordance with FBC 443.3 and Appendix F. All openings in walls and floors for piping shall be covered with wire cloth or sheet metal guards per Code.

### 3.18 SUPPORTS AND FASTENINGS

- A. Plumbing fixtures, trimmings, accessories and appurtenances shall be secured to concrete by 1/4 inch brass expansion bolts not less than 4 inches long, and to gypsum with steel plates 1/8 inch thick, 6 inches wide and not less than 24 inches long at the back of the through bolts. Expansion bolts shall be of a length sufficient to extend at least 3 inches into solid concrete. Through bolts shall be provided with plates or washers at the back and set so that heads, nuts and washers will be concealed by the wall material. Exposed heads of bolts and nuts shall be nickel-chromium-plated hexagons with rounded tops. Where necessary, nickel-chromium-plated brass washers shall be provided.

### 3.19 ANCHORING, GUIDING AND SUPPORTING OF PIPING

- A. All piping shall be anchored and supported in a manner such that expansion and contracting will take place in the direction desired and vibration dampeners. Hangers used for the support of piping, 2 inch nominal pipe size pipe and larger, shall be fabricated to permit adequate adjustment after erection while still supporting the load. Wall brackets shall be used where pipes are adjacent to wall or other vertical surfaces which may be used for supports. Supports shall be provided with a type 40 pipe covering protection saddle at each support in accordance with Table 4 of MSS SP-69. Pipe supports shall be spaced to provide adequate support for the pipes, the medium in the pipe, insulation, valves and fittings; spacing of supports shall be such as to prevent the forming of pockets. The maximum horizontal spacing for metal piping between pipe supports shall conform to Table 3 of MSS SP-69, except that cast iron soil pipe supports shall have a maximum spacing between hangers of 5 feet. Vertical piping shall be supported by bolted steel clamps or type conforming to MSS SP-69. Where copper piping comes in contact with hangers and anchors, the piping shall be wrapped with a rubberized tape extended 1/2" on each side of all Clevis hangers and straps.

### 3.20 STERILIZATION

- A. Prior to starting work, verify system is complete, flushed and clean.
- B. Ensure PH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
- D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- E. Maintain disinfectant in system for 24 hours.
- F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- H. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651. At least two samples, no less than six hours apart, shall be performed.
- I. A testing firm company specializing in testing potable water systems shall be approved by the State.
- J. A Certificate shall be submitted to Owner that cleanliness of water distribution system meets or exceeds State HRS requirements.
- K. On renovation work all procedures required above will be required for piping downstream of any shut-off valve turned off in order to do the work.
- L. If building is to be occupied, Contractor shall provide bottled water until Certificate has been received.

### 3.21 INSTRUCTION MANUALS

- A. Furnish four complete copies of instructions explaining operation and maintenance and replacement parts lists of the following equipment:
  - 1. Electric Water Coolers
  - 2. Domestic Water Heaters
  - 3. Faucet Trim
  - 4. Flush valves
  - 5. Shower/Eyewash
  - 6. Wall hydrants
  - 7. Water valves

3.22 AS-BUILT DRAWINGS

- A. Provide a complete set of reproducible "As-Built" drawings at job completion. Upon request, the Architect will provide the Contractor with reproducible copies of the contract drawings for the use in making these "As-Built" drawings.

3.23 FIELD TESTS

- A. Water supply piping shall be subjected to a hydrostatic pressure test of 100 psi minimum. Pressure shall be maintained on the lines for a period of time sufficient to examine the entire system but not less than one hour.
- B. Sanitary Piping: Before the installation of any fixtures, the ends of the system shall be capped and all lines filled with water to the roof and allowed to stand until a thorough inspection has been made. After the fixtures are set, a smoke or equivalent test shall be made using a suitable apparatus.
- C. Gas Piping: Shall be subjected to an air pressure of not less than 50 psi. Pressure shall be maintained on the lines for a period of time sufficient to examine the entire system but not less than one hour.

END OF SECTION



## SECTION 23 05 00

### BASIC MECHANICAL REQUIREMENTS

#### PART 1 - GENERAL

##### 1.1 GENERAL REQUIREMENTS

- A. The requirements of the Contract Documents apply to all work in all sections of Division 23.

##### 1.2 SCOPE OF WORK

- A. Provide new constant volume face and by pass 6000 CFM AHU and distribution system for kitchen area. Kitchen to have new hood with roof top make up air systems with conditioned air supply. Reuse three existing chilled and hot water AHU's for serving line and staff dining area. Student dining area to be conditioned with a multi zone mini split VRV system equal to Daikin.

All diffusers in Buildings 2, 3, 5, 6 & 8 to be replaced with louvered faced diffusers. Building 9 and bank room registers to be replaced with drum louvers equal to Titus DL-SV type.

New controls to be added in kitchen and dining areas and connected to the existing EMCS systems. All graphics and programming to be updated to include new AHU's , mini splits in Building 2, 8 & 9 for OFF/ON control and scheduling.

Controls to be Digital EMCS with display graphics in the Administration Area.

All ductwork shall be galvanized per SMACN low pressure standards as a minimum design criteria.

##### 1.3 INTENT

- A. It is the intention of these Specifications and Drawings to call for finished work, tested, and ready for operation. Wherever the word "provide" is used, it shall mean "furnish and install complete and ready for use".

##### 1.4 CODES, RULES, REGULATIONS, PERMITS AND FEES

- A. All work shall comply with governing codes, ordinances and regulations of City, County, State and Federal authority having jurisdiction. Where local codes are not applicable, the work shall comply with the National Electrical Code, Standard Plumbing Code and Standard Mechanical Code. If two or more codes apply and are at a variance, the more stringent shall apply.
- B. Notify the Engineer of any observed conflicts between the Contract Documents and governing code. Engineer will issue instructions as to procedures. If the Contractor performs any work knowing it to be contrary to governing code and without notice to the Owner, he shall assume full responsibility therefore and shall bear all costs attributable thereto.
- C. All material and equipment for the electrical portions of the mechanical system shall bear the approval label or shall be listed by the Underwriters' Laboratories, Incorporated.

## 1.5 COMPLETE PERFORMANCE OF THE WORK

- A. Work shall be executed in strict accordance with the best practice of the trades in a thorough, substantial, workmanlike manner by competent workmen.

## 1.6 DRAWINGS

- A. The drawings are diagrammatic and attempt to give reasonable indications of the locations of apparatus. The drawings are not intended to show each item of material or a complete detail of all work to be done, but are for the purpose of illustrating material sizes, minimum equipment performance and special conditions necessary for the experienced mechanic to take off his material and, in conjunction with job site measurements, lay out his work. Each location shall be determined by reference to the Contract Drawings and Specifications and by actual measurements at the building, and in all cases shall be subject to the approval of the Engineer. Drawings are in no way to be scaled. The architectural drawings and details shall be examined for location of fixtures and equipment. All ductwork shall be located to miss other equipment, light fixtures, and piping.

## 1.7 SUBMITTALS

- A. General: The Contractor shall make submittals as required by the specifications. The Engineer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections. Units of weights and measures used on all submittals shall be the same as those used in the contract drawings or larger as required herein. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with contract requirements. Prior to submittal, all items shall be checked and approved by the Contractor, and each item shall be stamped, signed, and dated indicating action taken. Proposed deviations from the contract requirements shall be clearly identified. Submittals shall include items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals. Samples remaining upon completion of the work shall be picked up and disposed of in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations. Submit all systems in a single 3-ring binder for each system.

### B. Definitions

- 1. Shop Drawings
  - a. Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work.
  - b. Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the Contractor for integrating the product or system into the project.
  - c. Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be coordinated.
- 2. Product Data



- a. Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials or equipment for some portion of the work.
  - b. Samples of warranty language when the contract requires extended product warranties.
- 3. Samples
  - a. Physical examples of materials, equipment or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged.
  - b. Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project.
  - c. Field samples and mock-ups constructed on the project site establish standards by which the ensuring work can be judged. Includes assemblies or portions of assemblies which are to be incorporated into the project and those which will be removed at conclusion of the work.
- 4. Design Data
  - a. Calculations, mix designs, analyses or other data pertaining to a part of work.
  - b. Design Submittals and extensions of design submittals.
- 5. Test Reports
  - a. Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accord with specified requirements. Testing must have been within three years of date of contract award for the project.
  - b. Report which includes findings of a test required to be performed by the Contractor on an actual portion of the work or prototype prepared for the project before shipment to job site.
  - c. Report which includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after installation.
  - d. Investigation reports.
  - e. Daily checklists.
  - f. Final acceptance test and operational test procedure.
- 6. Certificates
  - a. Statements printed on the manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements. Must be dated after award of project contract and clearly name the project.
  - b. Document required of Contractor, or of a supplier, installer or subcontractor through Contractor, the purpose of which is to further quality of orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel qualifications.
  - c. Confined space entry permits.
  - d. Text of posted operating instructions.
- 7. Manufacturer's Instructions
  - a. Preprinted material describing installation of a product, system or material, including special notices and Material Safety Data sheets concerning impedances, hazards and safety precautions.
- 8. Manufacturer's Field Reports

- a. Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
      - b. Factory test reports.
  
  - 9. Operation and Maintenance Data
    - a. Data that is furnished by the manufacturer, or the system provider, to the equipment operating and maintenance personnel. This data is needed by operating and maintenance personnel for the safe and efficient operation, maintenance and repair of the item.
  - 10. Closeout Submittals
    - a. Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism.
  - 11. Approving Authority
    - a. Office authorized to approve submittal.
  - 12. Work
    - a. As used in this section, on- and off-site construction required by contract documents, including labor necessary to produce submittals, construction, materials, products, equipment, and systems incorporated or to be incorporated in such construction.
- C. Submittals
- 1. Engineers' approval is required for all submittals prior to ordering.
- D. Procedures for Submittals
- 1. Reviewing, Certifying, Approving Authority
    - a. Contractor organization shall be responsible for reviewing and certifying that submittals are in compliance with contract requirements. Approving authority on submittals is Engineer of Record unless otherwise specified for specific submittal.
  - 2. Constraints
    - a. Submittals listed or specified in this contract shall conform to provisions of this section, unless explicitly stated otherwise.
    - b. Submittals shall be complete for each definable feature of work; components of definable feature interrelated as a system shall be submitted at same time.
    - c. When acceptability of a submittal is dependent on conditions, items, or materials included in separate subsequent submittals, submittal will be returned without review.
    - d. Approval of a separate material, product, or component does not imply approval of assembly in which item functions.
  - 3. Scheduling
    - a. Coordinate scheduling, sequencing, preparing and processing of submittals with performance of work so that work will not be delayed by submittal processing. Allow for potential requirements to resubmit.
    - b. Except as specified otherwise, allow review period, beginning with receipt by approving authority, that includes at least 30 working days for submittals for approval and 20 working days for submittals for approval. Period of review for submittals begins when Engineer receives submittal.

- c. For submittals requiring review by multiple disciplines or engineers, allow review period, beginning when Engineer receives submittal.
- 4. Variations
  - a. Variations from contract requirements require Engineer's approval.
  - b. Considering Variations
    - 1) Discussion with Engineer prior to submission will help ensure functional and quality requirements are met and minimize rejections and resubmittals.
  - c. Proposing Variations
    - 1) When proposing variation, deliver written request to the Engineer, with documentation of the nature and features of the variation and why the variation is desirable and beneficial. If lower cost is a benefit, also include an estimate of the cost saving. In addition to documentation required for variation, include the submittals required for the item. Clearly mark the proposed variation in all documentation.
  - d. Warranting That Variations Are Compatible
    - 1) When delivering a variation for approval, Contractor warrants that this contract has been reviewed to establish that the variation, if incorporated, will be compatible with other elements of work.
  - e. Review Schedule Is Modified
    - 1) In addition to normal submittal review period, a period of 10 working days will be allowed for consideration by the Engineer of submittals with variations.
- 5. Contractor's Responsibilities
  - a. Determine and verify field measurements, materials, field construction criteria; review each submittal; and check and coordinate each submittal with requirements of the work and contract documents.
  - b. Advise Engineer of variation, as required by paragraph entitled "Variations."
  - c. Correct and resubmit submittal as directed by approving authority. When resubmitting disapproved transmittals or transmittals noted for resubmittal, the Contractor shall provide copy of that previously submitted transmittal including all reviewer comments for use by approving authority. Direct specific attention in writing or on resubmitted submittal, to revisions not requested by approving authority on previous submissions.
  - d. Complete work which must be accomplished as basis of a submittal in time to allow submittal to occur as scheduled.
  - e. Ensure no work has begun until submittals for that work have been returned as "approved," or "approved as noted", except to the extent that a portion of work must be accomplished as basis of submittal.
- 6. Actions Possible
  - a. Submittals will be returned with one of the following notations:
    - 1) Submittals marked "not reviewed" will indicate submittal has been previously reviewed and approved, is not required, does not have evidence of being reviewed and approved by Contractor, or is not complete. A submittal marked "not reviewed" will be returned with an explanation of the reason it is not reviewed. Resubmit submittals

returned for lack of review by Contractor or for being incomplete, with appropriate action, coordination, or change.

- 2) Submittals marked "approved" "approved as submitted" authorize Contractor to proceed with work covered.
- 3) Submittals marked "approved as noted" or "approval except as noted; resubmission not required" authorize Contractor to proceed with work as noted provided Contractor takes no exception to the notations.
- 4) Submittals marked "revise and resubmit" or "disapproved" indicate submittal is incomplete or does not comply with design concept or requirements of the contract documents and shall be resubmitted with appropriate changes. No work shall proceed for this item until resubmittal is approved.

E. Format of Submittals

1. Transmittal Form: Transmit each submittal, except sample installations and sample panels, to office of approving authority. Transmit submittals with transmittal form prescribed by Engineer and standard for project. The transmittal form shall identify Contractor, indicate date of submittal, and include information prescribed by transmittal form and required in paragraph entitled "Identifying Submittals." Process transmittal forms to record actions regarding sample panels and sample installations.
2. Identifying Submittals: Identify submittals, except sample panel and sample installation, with the following information permanently adhered to or noted on each separate component of each submittal and noted on transmittal form. Mark each copy of each submittal identically, with the following:
  - a. Project title and location.
  - b. Construction contract number.
  - c. Section number of the specification section by which submittal is required.
  - d. Submittal description number of each component of submittal.
  - e. When a resubmission, add alphabetic suffix on submittal description, for example, "-A", to indicate resubmission.
  - f. Name, address, and telephone number of subcontractor, supplier, manufacturer and any other second tier Contractor associated with submittal.
  - g. Product identification and location in project.
3. Format for Shop Drawings
  - a. Shop drawings shall not be less than 8 1/2 by 11 inches nor more than 30 by 42 inches.
  - b. Present 8 1/2 by 11 inches sized shop drawings as part of the bound volume for submittals required by section or system as appropriate. Present larger drawings in sets.
  - c. Include on each drawing the drawing title, number, date, and revision numbers and dates, in addition to information required in paragraph entitled "Identifying Submittals."
  - d. Dimension drawings, except diagrams and schematic drawings; prepare drawings demonstrating interface with other trades to 3/8" -1'-0" scale. Identify materials and products for work shown.
  - e. Drawings shall include the nameplate data, size and capacity.
4. Format of Product Data and Manufacturer's Instruction's
  - a. Present product data submittals for each section as a complete, bound volume. Include table of contents, listing page and catalog item numbers for product data.
  - b. Indicate, by prominent notation, each product which is being submitted; indicate specification section number and paragraph number to which it pertains.

- c. Supplement product data with material prepared for project to satisfy submittal requirements for which product data does not exist. Identify this material as developed specifically for project, with information and format as required for submission of Certificates.
  - d. Product data shall include the manufacturer's name, trade name, place of manufacture, and catalog model or number. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified for Certificates.
  - e. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), ASTM International (ASTM), National Electrical Manufacturer's Association (NEMA), Underwriters Laboratories (UL), and Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Engineer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.
  - f. Submit manufacturer's instruction prior to installation.
5. Format of Samples
- a. Furnish samples in sizes below, unless otherwise specified or unless the manufacturer has prepackaged samples of approximately same size as specified:
    - 1) Sample of Equipment or Device: Full size.
    - 2) Sample of Materials Less Than 2 by 3 inches: Built up to 8 1/2 by 11 inches.
    - 3) Sample of Materials Exceeding 8 1/2 by 11 inches: Cut down to 8 1/2 by 11 inches and adequate to indicate color, texture, and material variations.
    - 4) Sample of Linear Devices or Materials: 10 inch length or length to be supplied, if less 10 inches. Examples of linear devices or materials are conduit and handrails.
    - 5) Sample of Non-Solid Materials: 750 ml or Pint. Examples of non-solid materials are sand and paint.
    - 6) Color Selection Samples: 2 by 4 inches.
    - 7) Sample Panel: 4 by 4 feet.
    - 8) Sample Installation: 100 square feet.
  - b. Samples Showing Range of Variation: Where variations are unavoidable due to nature of the materials, submit sets of samples of not less than three units showing extremes and middle of range.
  - c. Reusable Samples: Incorporate returned samples into work only if so specified or indicated. Incorporated samples shall be in undamaged condition at time of use.
  - d. Recording of Sample Installation: Note and preserve the notation of area constituting sample installation but remove notation at final clean up of project.
  - e. When color, texture or pattern is specified by naming a particular manufacturer and style, include one sample of that manufacturer and style, for comparison.
6. Format of Design Data and Certificates
- a. Provide design data and certificates on 8 1/2 by 11 inches paper. Provide a bound volume for submittals containing numerous pages.

7. Format of Test Reports and Manufacturer's Field Reports
    - a. Provide reports on 1/2 by 11 inches paper in a complete bound volume.
    - b. Indicate by prominent notation, each report in the submittal. Indicate specification number and paragraph number to which it pertains.
  8. Format of Preconstruction Submittals and Closeout Submittals
    - a. When submittal includes a document which is to be used in project or become part of project record, other than as a submittal, do not apply Contractor's approval stamp to document, but to a separate sheet accompanying document.
    - b. Provide all dimensions in administrative submittals in metric. Where data are included in preprinted material with English units only, submit metric dimensions on separate sheet.
- F. Quantity of Submittals
1. Number of Copies of Shop Drawings
    - a. Submit six copies of submittals of shop drawings requiring review and approval only by Engineer.
  2. Number of Copies of Product Data and Manufacturer's Instructions
    - a. Submit in compliance with quantity requirements specified for shop drawings.
  3. Number of Samples
    - a. Submit two samples, or two sets of samples showing range of variation, of each required item. One approved sample or set of samples will be retained by approving authority and one will be returned to Contractor.
    - b. Submit one sample panel. Include components listed in technical section or as directed.
    - c. Submit one sample installation, where directed.
    - d. Submit one sample of non-solid materials.
  4. Number of Copies Design Data and Certificates
    - a. Submit in compliance with quantity requirements specified for shop drawings.
  5. Number of Copies Test Reports and Manufacturer's Field Reports
    - a. Submit in compliance with quantity with quality requirements specified for shop drawings.
  6. Number of Copies of Operation and Maintenance Data
    - a. Submit three copies of O&M Data to the Contracting Officer for review and approval.
  7. Number of Copies of Preconstruction Submittals and Closeout Submittals
    - a. Unless otherwise specified, submit administrative submittals compliance with quantity requirements specified for shop drawings.
- G. Approved Submittals: The Engineer's approval of submittals shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory design, general method of construction, materials, detailing and other information appear to meet the Solicitation and Accepted Proposal. Approval will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work. After submittals have been approved by the Engineer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary and there will be a cost associated with the additional review of \$175/hour, \$500 minimum. The same applies for value engineering and product substitution analysis. Invoice is to be paid prior to release of reviewed submittal.

- H. Disapproved Submittals: The Contractor shall make all corrections required by the Contracting Officer and promptly furnish a corrected submittal in the form and number of copies specified for the initial submittal. The Contractor shall make all corrections required by the Engineer, obtain the Designer of Record's approval when applicable, and promptly furnish a corrected submittal in the form and number of copies specified for the initial submittal. Any "information only" submittal found to contain errors or unapproved deviations from the Solicitation or Accepted Proposal shall be resubmitted as one requiring "approval" action, requiring Designer of Record approval. If the Contractor considers any correction indicated on the submittals to constitute a change to the contract, a notice in accordance with the Contract Clause "Changes" shall be given promptly to the Owner. Resubmittals shall be reviewed at an hourly rate of \$175/hour, \$500 minimum per required review.
- I. Withholding of Payment: Payment for materials incorporated in the work will not be made if required approvals have not been obtained. No payment for materials incorporated in the work will be made if all required Designer of Record approvals have not been obtained. No payment will be made for any materials incorporated into the work for any conformance review submittals or information only submittals found to contain errors or deviations from the Solicitation or Accepted Proposal.

#### 1.8 SPACE LIMITATIONS

- A. Equipment shall be chosen which will properly fit into the physical spaces provided and indicated, allowing ample room for access, servicing, removal and replacement of parts, etc. Adequate space shall be allowed for clearance in accordance with the Code requirements and the requirements of the local inspection department. Physical dimensions and arrangements of equipment to be installed shall be subject to the Engineer review. However, since space requirements and equipment arrangement vary according to manufacturer, the responsibility for initial access and proper fit rests with the Contractor.
- B. Piping, domestic pressure piping, control conduit, roof drains or gravity piping shall be routed in the bar joist where and when possible such as to minimize conflicts with ductwork, light fixtures, ceilings, equipment and other items installed between the bottom of the bar joist and the ceiling.

#### 1.9 COORDINATION AND INTERFERENCES

- A. The Contractor shall give full cooperation to other trades. Where the work of the Contractor will be installed in close proximity to or will interfere with work of other trades, he shall assist in working out space conditions to make a satisfactory adjustment. Shifting of ductwork to clear light fixtures, piping walls, conduit, equipment, etc. shall be the Contractor's responsibility and shall be considered cooperation with other trades. If required and/or directed by the Engineer, the Contractor shall prepare composite working drawings and sections at a scale of 1/2" is equal to 1'-0", clearly showing how his work is to be installed in relation to the work of other trades and structures or inserts in poured walls. If the Contractor installs his work before coordinating with other trades, or so as to cause any interference with work of other trades or structures, he shall make the necessary changes in his work to correct the condition without additional cost to the Owner.

#### 1.10 SLEEVES, CUTTING AND PATCHING

- A. This Contractor shall be responsible for providing and the timely placing of sleeves for all piping passing through walls, partitions, beams, floors, and roof while same are under construction. A pipe sleeve shall be one size larger than the size of pipe it serves. If a pipe is insulated, its pipe sleeve shall be one size larger than the outside diameter of the insulation around the pipe. Sleeves set in concrete floor construction shall be 18 gauge galvanized steel except at pipe supports. Sleeves supporting pipes shall be Schedule 40 galvanized steel with three 6" long reinforcing rods welded at 120 degree spacing to the sleeve and shall be installed with the rods embedded in the concrete slab. Sleeves in floors shall extend four inches above the finished floor. All pipes passing through concrete or masonry walls shall have 18 gauge galvanized steel sleeves. If holes and/or sleeves are not properly installed and cutting and patching becomes necessary, it shall be done at no expense to the Owner by parties approved by the Engineer. The Contractor shall undertake no cutting or patching without first securing the Engineer's written approval.
- B. Where a pipe passes through a sleeve, no point of the pipe or its insulation shall touch the sleeve. Caulk around such pipe with sufficient quantity of fire safing insulation to equal fire rating of construction and seal off opening between pipe and pipe sleeve with a non-hardening mastic.

#### 1.11 ESCUTCHEONS

- A. Provide heavy chrome-plated or nickel-plated plates or approved pattern on piping passing through walls and ceiling in finishing areas. Escutcheons shall be B & G No. 10 or equal chrome-plated steel plates with concealed hinges. Pattern shall be approved by the Engineer.

#### 1.12 EXCAVATION AND BACKFILL

- A. This Contractor shall make all necessary excavations, cutting of paving, concrete, etc., and do all backfilling and paving repairs necessary for the proper execution of the Mechanical work. All installations below grade shall have a minimum of 24 inches cover or greater where indicated herein or on Plans.

#### 1.13 PAINTING

- A. Machinery furnished by this Contractor shall be factory-finished. If the factory finish is damaged during shipment, installation, etc., it shall be repainted subject to the Engineer's approval. See individual Specifications for additional painting requirements.

#### 1.14 MATERIALS

- A. Materials and equipment shall be new and of first-class quality. The commercially standard items of equipment and the specific names mentioned herein are intended to fix the standards of quality and performance necessary for the proper functioning of the Mechanical Work.
- B. All materials and equipment covered in this specification shall be new and shall fit in spaces provided. All equipment, fixtures and accessories shall carry a guarantee against defects for a period of one (1) year from the date of acceptance. Each system, as a whole and in all its parts, shall be guaranteed to function correctly up to the specified capacity for a minimum of one (1) year. Should a system or any part thereof fail to meet performance requirements, necessary replacements, alterations or repairs shall be made to bring performance up to specified requirements. All building construction and finishes damaged or marred shall be restored to the



satisfaction of the Owner's Representative. All the above described shall be done without cost to the Owner. Each major component of the equipment shall have the manufacturer's name, address and catalog number on a plate securely affixed in a conspicuous place. The above guarantee shall include the replacement of all refrigerant lost.

- C. Since manufacturing methods vary, reasonable minor equipment variations are expected; however, performance and material requirements are minimum. The Engineer retains the right to judge equality of equipment that deviates from the specifications.

#### 1.15 WELDING SPECIFICATIONS

- A. All field made pressure vessel welds shall be radiographed (x-rayed) in accordance with the requirements of ASME/ANSI B31.9.
- B. All branch, fillet, and socket welds on piping system shall be TP (dye-checked), or MT (magnetic particle) examined in accordance with the requirements of ASME/ANSI B31.9.
- C. The Contractor shall submit, as a Shop Drawing submittal, a copy of the Welding Procedure Specifications (WPS) that he plans to use on the project along with the Procedure Qualifications Records (PQR) that qualify these WPS's. All WPS's and PQR's shall be done in accordance with the requirements of ASME Section IX.
- D. All Welding Procedures Specifications (WPS) shall be qualified by the Contractor. Welding Procedures Specifications qualified by other Contractors or other Agencies will not be accepted. The Contractor must qualify all his own WPS's.
- E. All welders used on the project shall be qualified for the welds they will be making in accordance with ASME Section IX. The Welder Qualifications Performance (PQR) for each welder shall be current in accordance with the requirements of ASME Section IX.
- F. All welders used by the Contractor shall be tested and qualified under his employ and to the requirements of ASME IX. Welders who are qualified by other Contractors or Agencies will not be accepted. The Contractor must qualify his welders.
- G. The Welding Performance Qualifications (WPO) for each welder shall be recorded on an appropriate form (QW-484) that indicates actual test variables and qualification ranges. The WPO form for each welder shall be signed by the Contractor and certified. Copies of the WPO records for each welder shall be submitted to the Engineer prior to any production welding on the project by the Contractor.

#### 1.16 IDENTIFICATION OF EQUIPMENT, PIPING, AND VALVES

- A. Mechanical equipment and motor controllers shall be identified by means of nameplates permanently attached to the equipment. Nameplates shall be engraved laminated plastic with letters at least 1/4" high.
- B. Valves shall have identification markers; either engraved plastic or brass tags, permanently attached.
- C. Nameplate designations shall correspond to the identifications on the "Record Drawings" or "As Built Record Drawings".

#### 1.17 EQUIPMENT PADS AND ANCHOR BOLTS

- A. Equipment pads shall be provided for all floor-mounted equipment, for all equipment supported off the floor on legs, and for all pipe support stands. An equipment pad shall generally conform to the shape of the piece of equipment it serves with a minimum 6" margin around the equipment and supports. Pads shall be 28-day, 3000 psi concrete reinforced with 6" x 6" 10/10 gauge welded wire mesh minimum or greater as indicated on Plans. Top and sides of pad shall be troweled to smooth finishes, equal to those of the floors, with all external corners bull nosed to a 3/4" radius with a minimum thickness of 3½ inches.
- B. The Contractor shall furnish templates and anchor bolts for all equipment placed on concrete equipment pads or on concrete slabs. Bolts shall be of the size and number recommended by the manufacturer of the equipment and shall be located by means of suitable templates. When equipment is placed on vibration isolators, the equipment shall be secured to the isolator and the isolator secured to the floor, pad, or support as recommended by the vibration isolation manufacturer.

#### 1.18 LUBRICATION

- A. Where necessary, provide means for lubricating all bearings and other machine parts. If a part requiring lubrication is concealed or inaccessible, extend a lubrication tube with suitable fitting to an accessible location and suitably identify it.
- B. After installation, properly lubricate all parts requiring lubrication and keep them adequately lubricated until final acceptance by the Owner.

#### 1.19 ACCESS DOORS

- A. Wherever access is required through walls or ceilings to valves, fire dampers, or other concealed equipment installed under this Division, the Contractor shall furnish and install a hinged access door and frame with a flush latch handle. Contractor shall furnish complete information to the Engineer as to the number, size and location of required access doors. All shall be finished to match adjacent surfaces or as approved by Architect/Engineer. All doors shall be 24 x 24 inches minimum in size or sized to all removal of equipment.

#### 1.20 PRECLEANING AND PASSIVATION PROCEDURES FOR OPEN RECIRCULATING AND CLOSED LOOP COOLING SYSTEMS

- A. General
  1. The precleaning of the system refers to the removal of debris, solid materials, oil, and corrosion products that have accumulated in the system, as it has been idle during construction or during a system shutdown. Precleaning is a combination of mechanical and chemical methods. Precleaning provides a clean, chemically reactive surface, which will react with corrosion passivation treatments.
  2. The passivation or pre-filming of the system pertains to the promotion of the formation of protective oxide films, which will help prevent future corrosion. It is important to apply the passivation process immediately after the precleaning procedure to prevent incomplete formation and subsequent rapid corrosion and build up of associated corrosion products.
  3. Other considerations include considering discharge limits on various chemical components used during the process. Use of lower pH waters may require neutralization

prior to discharge. The dislodging of debris and corrosion product may increase clogging in filters. Backwashing and increased filter maintenance may be required.

B. Precleaning

1. Remove debris: Remove all accumulated debris such as wood, trash, leaves and sediments. Clean the deck, basin and screens by sweeping prior to filling the basin with fresh water. Avoid the use of wire brushes on galvanized surfaces.
2. Tower wood wash down for newly constructed or refurbished cooling towers: Wash tower wood down with fresh water prior to filling the tower basin. Water used for washing of tower wood shall be discharged prior to stating the chemical cleaning procedure. Tower wood structures shall be treated with copper based salts as microbiocides and removal of residual salts from the wood surfaces. 50 parts of active azole shall be present in the system during tower wood washing to complex copper solubilized during the wash down procedure.
3. Flush and fill basin: Fill the tower basin with fresh water, preferably the same as will be used for system makeup. Circulate through supply and return header system and across tower before flushing exchangers if possible.
4. Flush and fill exchangers: Open drains at exchanger low points and back flush, if possible. Check back pressures and pressure drops to ensure there are no blockages. Depending on the size of the system, it is recommended to purge the system and refill with fresh makeup. If large volumes restrict a complete purge, blowdown the system and add fresh makeup to dilute the solids and iron.

C. Precleaning Option #1 - Ferroquest

1. Recommended for non-galvanized open recirculating systems and closed loop systems. Caution: This procedure will remove galvanizing.
2. Products required:
  - a. Ferroquest FQ7101 or equal - A 0.5% to 2.0% of system volume charge of the product. For example, you will need between 50 and 200 gallons for a 10,000 gallon system.
  - b. Ferroquest FQ7102 neutralizer or equal - 0.1% of system volume of product. For example, you will need approximately 10 gallons for a 10,000 gallon system.
  - c. Anti-foam.
  - d. Non-oxidizing biocide to achieve 50 to 70 ppm. Do not exceed registered maximum as indicated on product label.
  - e. Maintain pH for 12 to 72 hours.
  - f. Monitor iron levels and pH.
3. Procedure:
  - a. Make sure there is enough excess system volume for the FQ7101 or equal product.
  - b. Make sure all automatic and manual valves are open for the entire cleaning.
  - c. Add heat load to system, attempting to maintain hot returns in the 120 to 160 degrees F range. Maintain temperatures below the maximum specified for the tower fill.
  - d. Charge system with FQ product or equal in an area of high mixing.
  - e. Recirculate and control pH in the 6.5 to 7.0 range. Add FQ7102 or equal as needed to keep pH in this range. If FQ7102 is not available you may use any excess FQ7101 for this purpose.
  - f. Recirculate the system for 12 to 72 hours. Lower concentrations of product will require longer recirculation times.

- g. During cleaning, flush through drain valves occasionally during the cleaning to remove scales and deposits that have been liberated by the cleaning. Keep open for approximately 15 seconds.
- h. Monitor iron levels and pH during the cleaning. If iron levels exceed 1200 ppm replace one-half the volume of the system with fresh water and add appropriate amount of new product.
- i. When iron levels plateau or you run out of precleaning time, flush the system (for small cooling towers and closed loops) or blowdown heavy to remove product, iron and any scale removed. Flush through all valves and inspect for deadlegs.
- j. Once system water is near make up water conductivity and iron levels, immediately institute recommended water treatment program and avoid keeping pre-clean solution in system for long periods of time.

D. Precleaning Option #2 - Multiple Chemical Approach for Non-Galvanized Systems

1. Products required:
  - a. HPS-1 dispersant product or equal to achieve 25 to 100 ppm active polymer.
  - b. HRA or equal to achieve 8 to 20 ppm active HRA.
  - c. Non-oxidizing biocide to achieve 50 to 75 ppm as product. Do not exceed registered maximum as indicated on product label.
  - d. Provide 100 to 200 ppm active pyrophosphate.
  - e. Surfactant at approximately 20 to 50 ppm as product - should provide oil/grease dispersancy as well as general surfactant properties.
  - f. Antifoam as needed.
  - g. If an oxidizing biocide is used at this point, keep levels at or below 1.0 ppm free residual chlorine.
  - h. Sulfuric acid may be required for pH control.
2. Procedure:
  - a. Make sure tower or system is full with fresh make up water. Begin to circulate water through system and bypass tower fill if possible.
  - b. Control pH in the 6.0 to 7.0 range.
  - c. Add chemicals to tower basin or system near pump screens show wise to achieve desired concentrations. Add products in order as given above or minimally, add HPS-1 or equal dispersant and HRA azole first.
  - d. Add heat load to system, attempting to maintain hot returns in the 120 to 160 degrees F range. Make sure to maintain temperatures below the maximum specified for the tower fill.
  - e. Circulate for 8 to 24 hours. If there is little heat load, allow to go for the full 24 hours.
  - f. After specified time open blowdown(s) to and makeup with fresh water. It is important to remove chemical and any dispersed solids, oils, etc. at this point.
  - g. Immediately institute passivation/pre-filming procedure and avoid keeping precleaning solution in system for long periods of time.

E. Precleaning Option #3 - Galvanized Systems

1. Make sure all chemicals are on-site and that pH control is available. If possible the tower or system should be exposed to atmosphere for 4 to 6 weeks prior to start up.
2. Products required:
  - a. HPS-1 dispersant or equal product to achieve 25 to 100 ppm active polymer.
  - b. HRA or equal to achieve 8 to 20 ppm active HRA.

- c. Non-oxidizing biocide to achieve 50 to 75 ppm as product. Do not exceed registered maximum as indicated on product label.
- d. Surfactant at approximately 20 to 50 ppm as product - provide oil/grease dispersancy as well as general surfactant properties.
- e. Antifoam as needed.
- f. If an oxidizing biocide is used at this point, keep levels at or below 1.0 ppm free residual chlorine.
- g. Sulfuric acid may be required for pH control.

3. Procedure:

- a. Make sure tower or system is full with fresh make up water. Begin to circulate water through system and bypass tower fill if possible.
- b. Control pH in the 7.0 to 8.0 range.
- c. Add chemicals to tower basin or system near pump screens shot wise to achieve desired concentrations. Add products in order as given above or minimally, add HPS-1 dispersant and HRA azole first.
- d. Add heat load to system, attempting to maintain hot returns in the 120 to 160 degree F range. Make sure to maintain temperatures below the maximum specified for the tower fill.
- e. Circulate for 8 to 24 hours. If there is little heat load, allow to go for the full 24 hours.
- f. After specified time open blowdown(s) to and makeup with fresh water. It is important to remove chemical and any dispersed solids, oils, etc. at this point.
- g. Immediately institute passivation/pre-filming procedure and avoid keeping precleaning solution in system for long periods of time.

F. Passivation/Pre-Filming Option #1 - Chemical Procedure for Non-Galvanized Open Recirculating Systems

- 1. Products Required: Utilize product or products to provide the following constituents. Consult water treatment company for appropriate products.
  - a. HPS-1 @ 20 to 100 ppm active polymer or equal.
  - b. HRA at approximately 5 to 20 ppm active azole or equal.
  - c. Orthophosphate levels for the following calcium levels:
    - 1) 35 to 100 ppm orthophosphate if Ca is <200 ppm.
    - 2) 35 to 50 ppm orthophosphate if Ca is 200 to 400 ppm.
    - 3) 35 to 50 ppm orthophosphate if Ca is >400 ppm.
  - d. Non-oxidizing biocide to achieve 50 to 75 ppm as product. Do not exceed registered maximum as indicated on product label.
- 2. Procedure:
  - a. Control pH in the 6.0 to 7.0 range.
  - b. Ideally temperature should be approximately 102 degrees F.
  - c. Add product(s) to achieve residuals as indicated above and add products in order shown above.
  - d. Circulate for 8 to 24 hours (24 hours if temperatures are near ambient).
  - e. Do not exceed a maximum of 48 hours.
  - f. Blowdown the system to achieve target residuals and ion levels prescribed by the standard treatment method. Adjust product feed rates of current product(s) or begin standard treatment program when desired cycles are reached.

- g. Alkaline treatment programs can be started once the alkalinity is 150 ppm or greater and the phosphate level is <7 ppm. Decrease or stop acid feed to allow alkalinity to cycle up.
  - h. Continue circulation through all piping and exchangers to minimize corrosion and microbial fouling.
  - i. At this point, do not drain and dry the system. If this is done, the passivation program will have to be repeated.
  - j. Maintain all treatment programs including deposition, corrosion, and biocide to keep system in good operating order.
- G. Passivation/Pre-Filming Option #2 - Chemical Procedure for Passivation/Pre-Filming of Galvanized Open Recirculating Systems
- 1. For the first 30 to 60 days of system operation, control the system pH in the 7.0 to 8.0 range.
  - 2. If an oxidizing biocide is used (chlorine or bromine based) keep free residual as chlorine below 1.0 ppm.
  - 3. Maintain standard high orthophosphate, low phosphonate cooling water treatment programs during this time. Excessive phosphonate levels are detrimental to zinc coated surfaces.
  - 4. Moderate calcium hardness levels of 100 to 300 ppm as CaCO<sub>3</sub> and alkalinity levels of 50 to 150 ppm as CaCO<sub>3</sub> are ideal during the 30 to 60 day passivation period.
  - 5. Once the 60-day passivation period is complete, desired treatment technology can begin including programs that include higher cycles to achieve higher alkalinity and hardness levels.
- H. All systems shall be filled with neutralized (PH7) water then adjusted to meet equipment supplier specifications.

## 1.21 OPERATING INSTRUCTIONS

- A. This Contractor shall provide the services of a competent Operating Engineer to supervise the operation of all equipment specified herein and to instruct the Owner's operators during an 8-hour operating period. The operating instruction period shall be identified as straight time working hours and shall not include nights, weekends, or travel time to and/or from the project.
- B. In addition, the manufacturers of the automatic temperature controls shall furnish the services of competent control men to instruct the Owner's operators as set forth in various sections. The operating instruction periods shall be as defined in the immediate preceding paragraph.
- C. The Owner shall be notified in writing at least five days before each operating instruction period begins. The Contractor shall commence no instruction period until the Owner has issued its written acceptance of the starting time.

## 1.22 OPERATING AND MAINTENANCE BOOKS

- A. The Contractor shall provide the Owner, through the Engineer, with operating instructions and maintenance data books for all equipment and materials furnished under this Division.

- B. Include the following information where applicable.
  - 1. Identify name and mark number.
  - 2. Locations (where similar items are used, provide a list).
  - 3. Complete nameplate data.
  - 4. Certified Record Drawings and Shop Drawings.
  - 5. Parts Lists.
  - 6. Performance Curves.
  - 7. Wiring Diagrams.
  - 8. Lubrication charts.
  - 9. Manufacturer's operating and maintenance instructions with all non-applicable information deleted.
  - 10. Supplier's name, address, and phone number.
- C. Maintenance instruction manuals shall include complete oiling, cleaning, and servicing data compiled in clearly and easily understandable form. Data shall show all series numbers of each piece of equipment, complete lists of replacement parts, motor ratings, and actual loads.
- D. In addition, a clear and concise operation diagram in a laminated cover shall be provided for each system. The location of these diagrams shall be coordinated with the Engineer and the Owner.
- E. Complete Test and Balance Report on each item.

#### 1.23 WATERPROOFING

- A. Where roofing or waterproof members are pierced with piping and sleeves, provide waterproofing as detailed. Where not detailed, provide lead flashing, oakum and lead caulking, lead sleeves and clamps, or other means approved by the Architect/Engineer to make the membrane watertight.

#### 1.24 MACHINERY GUARDS

- A. Provide all belts, couplings, wheels, and other moving parts of machinery with easily removable metal guards. Provide tachometer openings for all belt-driven or variable speed machinery.

#### 1.25 EQUIPMENT PROTECTION

- A. The Contractor shall protect all work and material from damage by his work or workmen, and shall be liable for all damage thus caused.
- B. The Contractor shall be responsible for all work and equipment until finally inspected, tested, and accepted by the Engineer and Owner; he shall carefully store material and equipment received on site and which are not immediately installed from the weather in a manner approved by the Owner.

#### 1.26 MANUFACTURER'S RECOMMENDATIONS

- A. With exceptions as specified and/or indicated on the Drawings or in the specifications, apply, install, connect, erect, use, clean, and condition manufactured articles, materials, and equipment per manufacturer's current printed recommendations. Keep copies of such printed recommendations at Job Site and make them available to the Engineer. The most stringent requirements shall be enforced.

## 1.27 ELECTRICAL COMPONENTS FOR MECHANICAL EQUIPMENT

- A. The electrical components of mechanical equipment, such as motors, motor starters, control or push-button stations, float, temperature or pressure switches, solenoid valves, heating elements, contractors, transformers and relays and other devices functioning to control and operate mechanical equipment, and control wiring and conduit for circuits rated less than 100 volts are specified in the sections covering the associated mechanical equipment and/or controls. The interconnecting power wiring and conduit, control wiring rated 120 volts (nominal) and greater and associated conduit, and the electrical power circuits are specified in and provided by Division 26.
- B. All components, including but not limited to, motors, motor starters, control or push-button stations, float, temperature or pressure switches, solenoid valves, and other devices functioning to control mechanical equipment and the individual component fusible protection for accessory equipment shall be provided under Division 23 in accordance with the National Electrical Code and as specified herein. These components shall be furnished by the Division 23 equipment manufacturer whenever they are available as standard or optional accessories. Components which are not installed within the manufactured equipment shall be furnished as specified in Division 23 and 26 and installed as specified in Division 26, NEC and local codes. All components shall be of the highest quality as indicated by Contract Documents.
- C. Electrical work specified in this Division shall conform to applicable provisions of Electrical Division and drawings. All control wiring shall be in conduit.
- D. Disconnecting means shall be provided as required by the National Electrical Code and shall be fused or non-fused as required by equipment manufacturer's nameplate data or local code. Disconnecting means when available as a factory integral part of the equipment shall be furnished by the equipment manufacturer. All disconnects shall be as required by the equipment manufacturer, specified herein or indicated by Division 26 and on the Electrical Drawings.
- E. At the option of the Contractor or when specified or shown on the drawings external motor starters may be combined with the required disconnecting means as a combination starter. External combination starters and disconnecting means shall be furnished by Division 26 and installed as specified in Division 26. Internal combination motor starters and disconnects shall be furnished by equipment manufacturer in accordance to NEC, Division 26 and Electrical Drawings.
- F. It is the intent of these specifications to require complete and finished work, with all systems and equipment tested and ready for operation, in accordance with the sequence of operation. The Contractor shall be solely responsible for all required coordination between construction trades to ensure that all necessary components are furnished and installed in order to comply with the intent, Codes, manufacturer requirements, and Division 23 and 26 herein.

## 1.28 MOTORS FOR MECHANICAL EQUIPMENT

- A. All motors 1/2 horsepower and larger for fans, pumps, compressors, etc., shall be premium high efficiency type, totally enclosed fan cooled in all ambient, vault or damp to wet locations otherwise shall be open drip-proof and certified for VFD duty, squirrel cage induction type for operation at 60 hertz, phase and voltage as indicated on the electrical drawings, quiet ball bearing type, class S insulation, and shall include a motor terminal box meeting applicable codes.



- B. Where units are direct driven, the motor type may be as recommended by the equipment manufacturer unless noted otherwise in the Contract Documents. All belt driven motors shall have adjustable rails.
- C. Single phase motors 1/6 to 1/3 horsepower inclusive shall be split phase type for operation on 120 volt single phase current unless noted otherwise. Motors less than 1/6 horsepower shall be shaded pole type.
- D. Single phase motors over 1/3 horsepower shall be capacitor start, induction run of the voltage indicated on the electrical drawings.

#### 1.29 EQUIPMENT NOISE AND VIBRATION

- A. It is the intention to specify and for the Contractor to provide equipment and systems, that as defined herein, will be quiet and free of apparent vibration in operation.
- B. It is intended that vibration shall not be apparent to the senses in occupied areas of the building. To this end, both the balancing of rotating machinery and the installation of vibration isolation at various locations are required.
- C. It shall be the responsibility of the Contractor to obtain equipment that is quiet in operation as compared to other available equipment of its size, capacity, and type; to install equipment so that a minimum amount of noise and/or vibration is transmitted to the structure; and to fabricate the duct system so that air noises generated in the system are held to an absolute minimum.
- D. Any additional precautions deemed necessary to provide a quiet installation shall be done as part of the work of this contract, subject to approval of the Engineer and without additional cost to the Owner. After the system is in operation, it shall be the responsibility of this Contractor to make any changes to equipment or work installed that may be required to provide a system which is quiet in operation as defined herein.
- E. Refer to plans for any specific noise level requirements.

#### 1.30 ELECTRICAL INSTALLATION REQUIREMENTS

- A. Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein in Division 23 and 26.
- B. All Work: Provide electrical components of mechanical equipment, such as motors, motor starters (except starters/ controllers which are indicated as part of a motor control center), control or push-button stations, float or pressure switches, solenoid valves, integral disconnects, and other devices functioning to control mechanical equipment, as well as control wiring and conduit for circuits rated 100 volts or less, to conform with the requirements of the section covering the mechanical equipment. Extended voltage range motors shall not be permitted. The interconnecting power wiring and conduit, control wiring rated 120 volts (nominal) and conduit, the motor control equipment forming a part of motor control centers, and the electrical power circuits shall be provided and installed under Division 26, except internal wiring for components of package equipment shall be provided as an integral part of the equipment. WHEN MOTORS OR ELECTRICAL EQUIPMENT FURNISHED ARE DIFFERENT THAN SIZES INDICATED ON SCHEDULES, THE MECHANICAL CONTRACTOR SHALL PROVIDE AND COORDINATE ANY AND ALL REQUIRED CHANGES TO THE ELECTRICAL SERVICE WITH THE ELECTRICAL

CONTRACTOR AS MAY BE NECESSARY AND RELATED WORK AS A PART OF THE WORK FOR THE SECTION SPECIFYING THAT MOTOR OR EQUIPMENT AT NO ADDITIONAL COST. ALL REQUIRED ELECTRICAL CHANGES AS PART OF THIS COORDINATION SHALL BE ACCOMPLISHED AS PART OF THIS CONTRACT AT NO ADDITIONAL COST TO THE OWNER.

1.31 DATE OF COMPLETION AND TESTING OF MECHANICAL SYSTEMS

- A. The date for the final acceptance test shall be sufficiently in advance of the contract completion date to permit the execution before the expiration of the Contract of any adjustments and/or alterations which the final acceptance tests indicate as necessary for the proper functioning of all equipment. Any such modifications shall be completed within the number of days allotted for completion of the Contract. Retests shall not relieve the Contractor for this Division of Completion date responsibility.
- B. After Substantial Completion the Contractor shall visit the site for 5 consecutive work days to ensure the equipment is operating appropriately.

1.32 FINAL REVIEW

- A. At a time designated by the Engineer, the entire system shall be reviewed. The Contractor shall be present at this review.
- B. The system shall be operating properly with all water and air volumes balanced and all temperature controls adjusted. All labels shall be removed from the plumbing fixtures and the fixtures shall be clean and in operating condition.
- C. Certificates and documents required herein shall be in order and presented to the Engineer at least four weeks prior to the review.
- D. After the review, any changes or corrections noted by the Engineer as necessary for the work to comply with these Specifications and the Drawings shall be accomplished without delay in order to secure final acceptance of the work.

1.33 GUARANTEE AND SERVICE

- A. Refer to General Conditions for guarantee. All Contractors for work under this Division shall have existing, a complete service office within 100 miles of job site.
- B. Where extended guarantees are called for herein, furnish three copies to be inserted in Instructions and Maintenance Manuals.
- C. The Contractor shall be responsible for labor to troubleshoot systems/equipment furnished by the Owner and all other systems/equipment called for by these Construction Documents for the duration of the minimum one year warranty period.
- D. Contractor shall perform preventative maintenance for a minimum period of one (1) year after substantial ~~inspection~~ **completion** and acceptance of project. Contractor shall provide all parts, labor, **filters** and fluids for all equipment supplied on this project for a minimum of one (1) year after Substantial Completion unless extended herein by specific Specification Sections.

#### 1.34 PRODUCT APPROVAL

- A. All products submitted and used on this Project shall bear the Florida Product Approval Seal or be on the approved lists. Shop Drawings shall be accompanied with a letter indicating or have printed on them the Florida Product Approval Number. Approval shall be per Florida Statute 553.842.
- B. All products mounted on the building envelope (roof, walls, canopies, etc.) shall have Wind Load Certification from manufacturer indicating attachment requirements and details showing exactly how to install and attach products to building, roof curb, and/or roof to comply with Project Wind Load Certification.

#### PART 2 - PRODUCTS

Not Used

#### PART 3 - EXECUTION

Not Used

END OF SECTION



SECTION 23 05 03

MECHANICAL IDENTIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Pipe Markers.

1.2 REFERENCES

- A. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS

- A. Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- B. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Product Data: Provide manufacturers catalog literature for each product required.
- D. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

1.4 PROJECT RECORD DOCUMENTS

- A. Submit record of actual locations of tagged valves.

2 PART PRODUCTS

2.1 NAMEPLATES

- A. Manufacturers:
- B. Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

2.2 TAGS

- A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.
- B. Chart: Typewritten letter size list in anodized aluminum frame.

## 2.3 STENCILS

- A. Manufacturers:
  - 1. Based on Seton Identification Products.
- B. Stencils: With clean cut symbols and letters of following size:
  - 1. 3/4 to 1-1/4 Inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 1/2 inch high letters.
  - 2. 1-1/2 to 2 Inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.
  - 3. 2-1/2 to 6 Inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1-1/4 inch high letters.
  - 4. Ductwork and Equipment: 2-1/2 inch high letters.
- C. Stencil Paint: Semi-gloss enamel, colors conforming to ASME A13.1.

## 2.4 PIPE MARKERS

- A. Manufacturers:
  - 1. Based on Seton Identification Products.
- B. Color: Conform to ASME A13.1.
- C. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

## 3PART EXECUTION

### 3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

### 3.2 INSTALLATION

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Install plastic pipe markers in accordance with manufacturer's instructions.
- D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- E. Identify air handling units, blower coils, fans, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line circulating pumps, may be identified with tags.
- F. Identify control panels and major control components outside panels with plastic nameplates.

- G. Identify valves in main and branch piping with tags.
- H. Tag automatic controls, instruments, and relays.
- I. Identify piping, concealed or exposed, with plastic pipe markers. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- J. Identify ductwork with stencils marking on both sides of ductwork. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction. Indicate direction of flow on ducts and piping systems.

END OF SECTION





## SECTION 23 05 29

### SUPPORTS AND ANCHORS

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Pipe hangers and supports.
- B. Hanger rods.
- C. Inserts.
- D. Flashing.
- E. Equipment curbs.
- F. Sleeves.
- G. Mechanical sleeve seals.
- H. Formed steel channel.
- I. Firestopping relating to mechanical work.
- J. Firestopping accessories.
- K. Equipment bases and supports.

##### 1.2 RELATED SECTIONS

- A. Section 230548 - Vibration Isolation.
- B. Section 220500 - Plumbing Piping.
- C. Section 230700 – Mechanical Insulation
- D. Section 232113 - Hydronic Piping.

##### 1.3 REFERENCES

- A. American Society for Testing and Materials:
  - 1. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
  - 2. ASTM E119 - Method for Fire Tests of Building Construction and Materials.
  - 3. ASTM E814 - Test Method of Fire Tests of Through Penetration Firestops.
  - 4. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
- B. American Welding Society:
  - 1. AWS D1.1 - Structural Welding Code - Steel.

- C. Factory Mutual System:
  - 1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.
- D. Manufacturers Standardization Society of the Valve and Fittings Industry:
  - 1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
  - 2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
  - 3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- E. Underwriters Laboratories Inc.:
  - 1. UL 263 - Fire Tests of Building Construction and Materials.
  - 2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
  - 3. UL 1479 - Fire Tests of Through-Penetration Firestops.
  - 4. UL - Fire Resistance Directory.
- F. Warnock Hersey:
  - 1. WH - Certification Listings.

#### 1.4 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

#### 1.5 SYSTEM DESCRIPTION

- A. Firestopping Materials: ASTM E119, ASTM E814, UL 263, UL 1479 to achieve fire ratings not less than 1 hour fire rating.

#### 1.6 REGULATORY REQUIREMENTS

- A. Conform to applicable code for support of plumbing hydronic piping.

#### 1.7 PERFORMANCE REQUIREMENTS

- A. Firestopping: Conform to applicable code for fire resistance ratings and surface burning characteristics.
- B. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

#### 1.8 SUBMITTALS

- A. Division 1 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers.

- C. Product Data:
  1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
  2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
- D. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.
- E. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- F. Manufacturer's Installation Instructions:
  1. Hangers and Supports: Submit special procedures and assembly of components.
  2. Firestopping: Submit preparation and installation instructions.
- G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- H. Engineering Judgments: For conditions not covered by UL or WH listed designs, submit judgments by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

#### 1.9 QUALITY ASSURANCE

- A. Perform Work in accordance with applicable authority for welding hanger and support attachments to building structure.
- B. Maintain one copy of each document on site.

#### 1.10 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum 3 years documented experience.

#### 1.11 PRE-INSTALLATION MEETINGS

- A. Division 1 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

#### 1.12 DELIVERY, STORAGE, AND HANDLING

- A. Division 1 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

- C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

#### 1.13 ENVIRONMENTAL REQUIREMENTS

- A. Division 1 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F (15 degrees C).
- C. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.

#### 1.14 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

#### 1.15 WARRANTY

- A. Division 1 - Execution Requirements: Product warranties and product bonds.
- B. Furnish one year manufacturer warranty for pipe hangers and supports.

### 2 PART PRODUCTS

#### 2.1 PIPE HANGERS AND SUPPORTS

- A. Furnish materials in accordance with State of Florida and SREF standards.
- B. Hydronic Piping:
  - 1. Conform to ASME B31.9, ASTM F708, MSS SP58, MSS SP69, MSS SP89.
  - 2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (13 to 38 mm): Malleable iron or Carbon steel, adjustable swivel, split ring.
  - 3. Hangers for Cold Pipe Sizes 2 inches (50 mm) and Larger: Carbon steel, adjustable, clevis.
  - 4. Hangers for Hot Pipe Sizes 2 to 4 inches (50 to 100 mm): Carbon steel, adjustable, clevis.
  - 5. Hangers for Hot Pipe Sizes 6 inches (150 mm) and Larger: Adjustable steel yoke, cast iron roll, double hanger.
  - 6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
  - 7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches (150 mm) and Larger: Steel channels with welded spacers and hanger rods, cast iron roll.
  - 8. Wall Support for Pipe Sizes 3 inches (76 mm) and Smaller: Cast iron hooks.
  - 9. Wall Support for Pipe Sizes 4 inches (100 mm) and Larger: Welded steel bracket and wrought steel clamp.
  - 10. Wall Support for Hot Pipe Sizes 6 inches (150 mm) and Larger: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
  - 11. Vertical Support: Steel riser clamp.
  - 12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

13. Floor Support for Hot Pipe Sizes 4 Inches (100 mm) and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
14. Floor Support for Hot Pipe Sizes 6 inches (150 mm) and Larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
15. Copper Pipe Support: Copper-plated, carbon steel ring.

C. Gas Piping:

1. Conform to ASME B31.9.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.
5. Hangers for Hot Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron roll, double hanger.
6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
8. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
9. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
10. Vertical Support: Steel riser clamp.
11. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

## 2.2 ACCESSORIES

- A. Hanger Rods: Galvanized mild steel threaded both ends, threaded on one end, or continuous threaded.

## 2.3 INSERTS

- A. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

## 2.4 FLASHING

- A. Metal Flashing: 24 gage (0.5 mm) thick aluminum.
- B. Metal Counterflashing: 22 gage (0.8 mm) thick aluminum.
- C. Lead Flashing:
1. Waterproofing: 5 lb./sq. ft (24.5 kg/sq m) sheet lead
  2. Soundproofing: 1 lb./sq. ft (5 kg/sq m) sheet lead.
- D. Flexible Flashing: 47 mil (1.2 mm) thick sheet butyl; compatible with roofing.
- E. Caps: Aluminum, 22 gage (0.8 mm) minimum; 16 gage (1.5 mm) at fire resistant elements.

## 2.5 EQUIPMENT CURBS

- A. Fabrication: Welded 18 gage (1.2 mm) aluminum and base, mitered 3 inch (75 mm) cant, factory installed wood nailer.
- B. Curbs shall be 12" above finish roof minimum and anchored to roof structure on four corners with 5/16" diameter fasteners minimum.
- C. Curbs shall also be anchored as detailed.

## 2.6 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage (1.2 mm) thick galvanized steel, through roof: 16 gage thick aluminum.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage (1.2 mm) thick galvanized steel.
- C. Sleeves for Round Ductwork: Galvanized steel.
- D. Sleeves for Rectangular Ductwork: Galvanized steel.
- E. Sealant: Acrylic.

## 2.7 MECHANICAL SLEEVE SEALS

- A. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

## 2.8 FORMED STEEL CHANNEL

- A. Product Description: Galvanized 12 gage (2.8 mm) thick steel. With holes 1-1/2 inches (38 mm) on center.

## 2.9 FIRE AND SMOKESTOPPING

- A. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
  1. Silicone Firestopping Elastomeric Firestopping: Single component silicone elastomeric compound and compatible silicone sealant.
  2. Foam Firestopping Compounds: Single component foam compound.
  3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
  4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
  5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
  6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to

- 7. surface heat gain.  
Firestop Pillows: Formed mineral fiber pillows.

B. Color: As selected from manufacturer's full range of colors.

## 2.10 FIRE AND SMOKE STOPPING ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

C. General:

1. Furnish UL listed products.
2. Select products with rating not less than rating of wall or floor being penetrated.

D. Non-Rated Surfaces:

1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

## 3 PART EXECUTION

### 3.1 EXAMINATION

A. Division 1 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify openings are ready to receive sleeves.

C. Verify openings are ready to receive firestopping.

### 3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.

B. Remove incompatible materials affecting bond.

C. Do not drill or cut structural members.

### 3.3 INSTALLATION - INSERTS

A. Install inserts for placement in concrete forms.

B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches (100 mm) and larger.

- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

#### 3.4 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with ASTM F708, MSS SP 58, MSS SP 69, MSS SP 89.
- B. Support horizontal piping as scheduled.
- C. Install hangers with minimum 1/2 inch (13 mm) space between finished covering and adjacent work.
- D. Place hangers within 12 inches (300 mm) of each horizontal elbow.
- E. Use hangers with 1-1/2 inch (38 mm) minimum vertical adjustment.
- F. Support horizontal cast iron pipe adjacent to each hub, with 5 feet (1.5 m) maximum spacing between hangers.
- G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Provide copper plated hangers and supports for copper piping.
- J. Design hangers for pipe movement without disengagement of supported pipe.
- K. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- L. Provide clearance in hangers and from structure and other equipment for installation of insulation.

#### 3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 3-1/2 inches (87 mm) thick and extending 6 inches (150 mm) beyond supported equipment. Refer to Division 3 or provide a minimum of 3000 PSI concrete mixture for all equipment pads.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

#### 3.6 INSTALLATION - FLASHING

- A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.



- B. Flash vent and soil pipes projecting 3 inches (75 mm) minimum above finished roof surface with lead worked 1 inch (25 mm) minimum into hub, 8 inches (200 mm) minimum clear on sides with 24 x 24 inches (600 x 600 mm) sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counter-flash, and seal.
- C. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms for sound control.
- D. Provide curbs for mechanical roof installations 14 inches (350 mm) minimum high above roofing surface. Flash and counter-flash with sheet metal; seal watertight. Attach Counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.
- E. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

### 3.7 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors 1 inch (25 mm) above finished floor level. Caulk sleeves.
- E. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with stuffing insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- F. Install stainless steel escutcheons at finished surfaces.

### 3.8 INSTALLATION – FIRE AND SMOKE STOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating.

### 3.9 FIELD QUALITY CONTROL

- A. Section 01700 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.10 CLEANING

- A. Section 01700 - Execution Requirements: Requirements for cleaning.
- B. Clean adjacent surfaces of firestopping materials.

3.11 PROTECTION OF FINISHED WORK

- A. Section 01700 - Execution Requirements: Requirements for protecting finished Work.
- B. Protect adjacent surfaces from damage by material installation.

3.12 SCHEDULES

PIPE HANGER SPACING

<u>PIPE SIZE</u>	<u>MAX. HANGER SPACING</u>	<u>HANGER ROD DIAMETER (minimum)</u>
Inches (mm)	Feet (m)	Inches (mm)
1/2 (12)	7 (2.1)	3/8 (9)
3/4 (20)	7 (2.1)	3/8 (9)
1 (25)	7 (2.1)	3/8 (9)
1-1/4 (32)	7 (2.1)	3/8 (9)
1-1/2 (38)	9 (2.7)	3/8 (9)
2 (50)	10 (3)	3/8 (9)
2-1/2 (65)	11 (3.4)	1/2 (13)
3 (75)	12 (3.7)	1/2 (13)
4 (100)	14 (4.3)	5/8 (15)
5 (125)	16 (4.9)	5/8 (15)
6 (150)	17 (5.2)	3/4 (19)
8 (200)	19 (5.8)	3/4 (19)
PVC (All Sizes)	4 (1.8)	3/8 (9)

C.I. Bell and  
Spigot (or No-Hub)  
And at Joints

5 (1.5)

5/8 (15)

END OF SECTION



SECTION 23 05 48

VIBRATION ISOLATION

PART 1 GENERAL

1.1 SUMMARY

- A. Scope: The extent of vibration isolation work to be provided under this Contract is covered by the requirements of this Section, Section 15010, "Mechanical Basic Requirements," and the Contract Drawings including structural, architectural, mechanical and electrical which identify equipment and systems requiring vibration isolation treatment.
- B. Types: Types of vibration isolation equipment and systems specified in this Section include:

TYPE	DESCRIPTION
1I Isolator	Ribbed Neoprene Pads
2I Isolator	Neoprene-In-Shear Type
2H Hanger	Rubber-In-Shear Type
3I Isolator	Open Spring Type
3H Hanger	Combination Spring and Neoprene Type
4 Isolator	Vertically Restrained Spring Isolators
5 Thrust	Restraints Spring Type Installed in Pairs
A Base	Directly Bolted Attachment
B Base	Structural Rails or Bases
C Base	Concrete Inertia Type

- C. Selection of Isolators: Provide isolators selected by a vibration isolator equipment specialist.
  - 1. Conform to isolator types herein specified.
  - 2. Examine the contract drawings for sizes, equipment power ratings, rotational speeds, equipment location, length of span between columns and beams and construction type to determine the isolator selection type and deflection required for each piece of mechanical equipment.
  - 3. Conform to the requirements of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Handbook, "HVAC Systems and Applications," Chapter 42, "Sound and Vibration Control."

1.2 QUALITY ASSURANCE

- A. Codes: Conform to the ASHRAE Handbook, "HVAC Systems and Applications," Chapter 42.
- B. Manufacturer: Isolators of the same type shall be the product of the same manufacturer. The manufacturer shall publish and maintain a full line of materials, engineering and application data and operating and maintenance instructions.

1.3 SUBMITTALS

- A. Contractor's Certification: Vibration isolator submittals shall include a certification, signed by an officer representing the Contractor and stipulating that the submittal prepared by the manufacturer has been reviewed, and checked on an item by item basis against each piece of mechanical

equipment, shown or specified in the Contract Documents, which requires vibration isolation.

- B. Manufacturer's Certification: The manufacturer shall certify that the selections of vibration isolation equipment are based upon the drawings and specifications, and that each piece of mechanical equipment has been examined for rotational speed, equipment type, mounting location, and supporting span between column centers, and that an appropriate isolator has been selected.
- C. Product Data: Furnish manufacturer's product data covering each isolator type for style, characteristic, and finish.
- D. Isolator quantities, dimensions, deflections, capacities and types shall remain the responsibility of the manufacturer and the Contractor.

#### 1.4 STORAGE AND PROTECTION

- A. Storage: Store vibration isolation equipment indoors in the manufacturer's original shipping containers. Preclude the entrance of construction dirt and debris.
- B. Vibration isolation equipment and bases, which show signs of rust, cement or concrete fouling, dirt and construction debris shall be disassembled and cleaned, approved or removed from the project site and replaced with new.

### 2 PART PRODUCTS

#### 2.1 MANUFACTURERS

- A. Isolation equipment shall be the products of a single manufacturer.
- B. Equipment by Mason Industries, Kinetics Noise Control, or Amber/Booth Company will be considered for approval.

#### 2.2 EQUIPMENT

- A. Selection: Exact mounting sizes, dimensions and quantity of isolators and static deflection required shall be determined by the isolator manufacturer based upon equipment that will be furnished and installed by the Contractor under this Contract.
  - 1. Vibration isolation specialist shall coordinate his work with that of other trades to verify that equipment speeds, in revolutions per minute (rpm), are based upon actual equipment installed at the project site.
  - 2. Verify that equipment rpm and spring deflection selected are arranged so that resonance is avoided.
  - 3. All isolators used outdoors shall be hot dipped galvanized.

#### 2.3 ISOLATOR TYPES

- A. Type 11 Isolators: Provide pad type vibration isolators consisting of either two layers ¼ inch thick elastomer, molded to contain a pattern with non-slip characteristics in all directions, and bonded to galvanized steel separator plates, or one inch thick precompressed molded fiberglass isolation pads. Minimum overall thickness shall be one inch. Deflection shall be limited to .025 inches or less. Loading shall not exceed 40 psi.

- B. Type 2I Isolators: Provide double rubber-in-shear or elastomer-in-shear with molded-in steel reinforcement in the top and bottom portions.
1. Deflections shall be limited to ½ inch or less.
  2. Steel bases shall be drilled with mounting holes and equipment mounting points shall be threaded male or female connections.
  3. Treat resilient material with antiozone and antioxidant additives.
- C. Type 2H Hangers: Provide rubber-in-compression suspension hangers, consisting of a formed steel frame and elastomer isolation element and provided with attachments for top and bottom suspension rods.
1. Design for a minimum 200 percent overload without noticeable deformation or failure.
  2. Design for minimum 30 degrees misalignment without binding or reducing the efficiency of the hanger.
  3. Metal components shall be galvanized and factory painted.
- D. Type 3I Isolators: Provide adjustable, freestanding, open spring isolators with combination leveling and equipment fastening bases.
1. Spring elements shall be contained in upper and lower housing assemblies and shall have a minimum Kx-Ky of 0.75.
  2. Design springs for a minimum travel of 50 percent beyond the rated load.
  3. When fully compressed and "bottomed-out", isolators shall be capable of supporting a 200 percent overload without deformation and spring failure.
  4. A minimum ¼ inch thick non-skid isolation pad shall be bonded to the underside of the base plate.
  5. Size base plates to limit floor loading to 100 psi.
  6. Drill base plates for bolting.
  7. Provide means for anchoring the top element of the isolator to rails and equipment.
- E. Type 3H Hangers: Provide combination spring and elastomer hangers consisting of a formed steel frame with coil spring and elastomer insert in compression.
1. Design hangers to be capable of supporting a 200 percent overload without noticeable deformation or failure.
  2. Design hangers to allow 30 degrees misalignment without binding or a reduction in hanger efficiency.
  3. Design hangers for connection to equipment and supporting rods.
- F. Type 4 Isolators: Provide vertically restrained, freestanding, laterally stable, open spring type isolators.
1. Design for deflection exceeding ½ inch.
  2. Provide built-in bearing and leveling provisions.
  3. Provide a non-slip elastomer vibration absorbing pad bonded to the underside of the isolator base.
  4. Outside diameter of each spring shall be equal to or greater than 0.9 times the operating height of the spring under rated load.
  5. Provide vertical limit stops to prevent hyperextension due to wind loads or upward movement when the load is removed. Limit stops shall not bind or inhibit spring movement during normal operating ranges.

- G. Type 5 Thrust Restraints: Provide spring isolators of an adjustable, freestanding type enclosed within tubular mountings and arranged to be installed in pairs across the discharge of fan flexible connectors.
1. Design restraints to resist the thrust caused by duct internal air pressure.
  2. Install restraints on duct systems with an internal static pressure exceeding 3 inches H<sub>2</sub>O.
  3. Restraints shall have the same deflection as isolators installed under the fans.

## 2.4 BASE TYPES

- A. Type A Bases: No supplementary base is required. Vibration isolators, specified elsewhere, shall be attached directly to the supported equipment or structural system.
- B. Type B, Structural Rails or Bases: Provide bases designed and supplied by the isolation equipment manufacturer.
1. Construct bases of mill rolled structural sections of sufficient dimension to limit the midpoint deflection or unsupported spans to 1/1440th of the span between isolators.
  2. Include equipment static loadings, power transmission, component misalignment and cantilever loadings when designing structural sections.
  3. When head room is limited, coordinate the design of structural rails and isolators to reduce mounting heights.
  4. Factory finish with two coats equipment enamel.
- C. Type C, Concrete Inertia Bases: Provide concrete inertia bases designed by the isolator manufacturer and arranged to be filled with concrete in the field.
1. Construct base of mill rolled structural steel sections, factory mitered and welded into a rigid frame and supporting No. 4 reinforcing bars welded to the structural frame 8 inches on centers both ways and located 2 inches from the bottom of the block.
  2. Arrange for outrigger isolation mountings, anchor bolts and equipment support.
  3. Field fill with 3000 psi cured-strength concrete. Trowel to a smooth hard finish.
  4. Clean structural steel of excess concrete and field paint all steel elements with two coats equipment enamel.
  5. Configuration of inertia bases shall be rectangular to accommodate equipment supported unless otherwise indicated.
  6. Minimum thickness of inertia bases, in addition to providing suitable mass, shall be sufficient to provide stiffness to maintain equipment manufacturer's recommended alignment and duty efficiency of power transmission.
  7. Minimum thickness shall be sufficient to result in a base deflection at midpoint of unsupported span of not more than 1/1440th of the span between isolators.
  8. Minimum thickness shall be 8 percent of the longest base dimension unless otherwise specified or indicated.
  9. For centrifugal pumps, the inertia bases shall be a minimum 12 inches thick.
  10. Where inertia bases are used to mount pumps, the bases shall be long enough to support piping elbows for all connections. All horizontal pumps shall include inertia bases as detailed in Drawings.



2.5 PIPING AND DUCTWORK

- A. General: All piping 1 inch diameter and larger in mechanical equipment rooms and to points ten feet away from the extremity of mechanical equipment rooms, shall be isolated from the building structure with flexible vibration isolators.
  - 1. Suspend piping on Type 3H hangers.
  - 2. Floor-mounted piping shall be supported with Type 3I spring isolators with deflections the same as the equipment to which the piping is attached.
- B. Reciprocating Equipment: Provide spring type hangers with deflections equal to that of reciprocating equipment, with piping arranged with offset elbows to absorb vibration.
- C. Risers: Pipe and duct risers within 10 feet of mechanical equipment rooms shall be resiliently anchored to the building structure with Type 1 vibration isolators, near the midpoint of the risers.
  - 1. Risers shall be isolated and supported at each second floor with pairs of Type 3H hangers, having deflections a minimum of 5 times the anticipated thermal movement at the support point.
  - 2. Risers shall be guided as required with four sets of Type 3I vibration isolators.
  - 3. Provide flexible neoprene or canvas connectors as specified in sheet metal ductwork at the connection point to all air moving equipment.
  - 4. Support ductwork with an internal pressure exceeding 3 inches H<sub>2</sub>O with Type 3H hangers on maximum 10 feet centers with deflections equal to the equipment isolators.

2.6 VIBRATION ISOLATION SYSTEM SELECTION

- A. General: The following selections of vibration isolation equipment systems shall be considered as a minimum. For the equipment below, the following code applies:
  - Letter (i.e. A, B, C) = Base type
  - Number (i.e. 1, 2, 3, 4) = Isolator type
  - Decimal number (i.e. 0.005, 0.01, etc.) = Minimum deflection (in inches)

B. Low-Pressure AHU Locations (to 3 inches H<sub>2</sub>O)

TYPE EQUIPMENT	ON GRADE	20'-30' FLOOR SPAN	30'-40' FLOOR SPAN	Over 40' FLOOR SPAN
Through 10HP	A 2 0.75	A 3 1.0	A 3 1.0	A 3 1.0
10 HP and Over	A 2 1.5	A 2 1.5	A 3 1.5	A 3 2.5
250 to 500 RPM	A 2 1.5	A 3 1.5	A 3 1.5	A 3 1.5
over 500 RPM				

C. Medium and High-Pressure AHU Location (Above 3 inches H<sub>2</sub>O total pressure)

TYPE EQUIPMENT	ON GRADE	20'-30' FLOOR SPAN	30'-40' FLOOR SPAN	Over 40' FLOOR SPAN
Through 20 HP	A 3 0.75	A 3 1.5	A 3 2.0	A 3 1.5
Over 20 HP	A 2 1.5	A 3 2.0	A 3 2.5	A 3.0

D. Air-Moving Device Locations: Vibration-isolation provisions apply to suspended housed or unhoused freestanding fans of any pressure rating, located in field-erected central-station units or in unhoused return-air or supply-air service.

TYPE EQUIPMENT	20'-30' FLOOR SPAN	30'-40' FLOOR SPAN	over 40' FLOOR SPAN
Up to 5 HP	B 3 1.0	B 3 1.0	B 3 1.0
5 Thru 40 HP	B 3 1.5	B 3 1.5	B 3 2.5
200 to 500 RPM	B 3 1.5	B 3 1.5	B 3 2.5
500 RPM and Over	C 3 1.5	C 3 1.5	C 3 1.5

E. Centrifugal Pumps:

TYPE EQUIPMENT	ON GRADE INDOORS	ON GRADE OUTDOORS
Base-Mounted through 40 HP	C 3 3/4	I 2 1/4

F. Air-Cooled Condensing and Chiller Units:

TYPE EQUIPMENT	ON GRADE
through 5 tons	I 1 1/16
above 5 tons	I 2 1/4

### 3PART EXECUTION

#### 3.1 INSTALLATION

- A. Manufacturer: All vibration isolation equipment shall be installed in accordance with the manufacturer's recommendations.
- B. Manufacturer's Representative: The vibration isolation installation and deflection testing after equipment start-up shall be conducted by a representative of the manufacturer.

#### 3.2 TESTS AND REPORTS

- A. Testing: Each vibration isolation device shall be deflection tested. Two copies of a bound report

shall be submitted prior to final acceptance. The certification shall include the following:

1. Certify that equipment has been isolated in accordance with Contract Drawings, specifications and submittals.
2. Certify that all minimum specified deflections have been equaled or exceeded.

### 3.3 ANCHORING

- A. Installation: Installation shall comply with manufacturer's published recommendations and shall be installed so that isolators are plumb and are operating at a manner for which they were designed.
  1. Unless otherwise specified, all equipment shall be securely bolted to isolators, steel bases or concrete inertia bases.
  2. Indoor vibration isolators need not be attached to the structure unless required by local codes.
  3. Isolators installed outdoors shall be attached to building structure.

### 3.4 CLEANING

- A. Debris: Remove all debris from under equipment, and thoroughly clean steel bases, inertia bases and check for free movement.
- B. Adjustment: Adjust isolators as required for proper operation prior to starting equipment. Testing of vibration isolators shall be performed by a certified representative of the manufacturer as specified.

END OF SECTION



## SECTION 23 05 93

### TESTING, ADJUSTING, AND BALANCING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Testing adjusting and balancing of air systems.
  - 2. Testing adjusting, and balancing of hydronic and refrigerating systems.
  - 3. Measurement of final operating condition of HVAC systems.
  - 4. Sound measurement of equipment operating conditions.
  - 5. Vibration measurement of equipment operating conditions.
  - 6. Measurement of final operating conditions of gas and compressed air systems.

##### 1.2 REFERENCES

- A. Associated Air Balance Council:
  - 1. AABC MN-1 - National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
  - 1. ASHRAE 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.
- C. Natural Environmental Balancing Bureau:
  - 1. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

##### 1.3 SUBMITTALS

- A. Division 1 - Submittal Procedures: Submittal procedures.
- B. Prior to commencing Work, submit proof of latest calibration date of each instrument.
- C. Test Reports: Indicate data on forms containing information indicated in Schedules.
- D. Field Reports: Indicate deficiencies preventing proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- E. Prior to commencing Work, submit report forms or outlines indicating adjusting, balancing, and equipment data required. Include detailed procedures, agenda, sample report forms.
- F. Submit draft copies of report for review prior to final acceptance of Project.
- G. Furnish reports in soft cover, letter size, 3-ring binder manuals, complete with table of contents page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Division 1 - Execution Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.
- C. Operation and Maintenance Data: Furnish final copy of testing, adjusting, and balancing report inclusion in operating and maintenance manuals.

#### 1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with AABC MN-1 National Standards for Field Measurement and Instrumentation, Total System Balance, ASHRAE 111, NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.
- B. Maintain one copy of each document on site.
- C. Prior to commencing Work, calibrate each instrument to be used. Upon completing Work, recalibrate each instrument to assure reliability.

#### 1.6 QUALIFICATIONS

- A. Test and Balance services for HVAC shall be provided by ~~the Contractor Agency employed by the Nassau County School District~~ and shall meet all requirements of the Florida Building Code. **Nassau County School District may obtain separate confirmation testing.**
- B. Perform work under supervision of AABC Certified Test and Balance Engineer or NEBB Certified Testing, Balancing and Adjusting Supervisor.

#### 1.7 PRE-INSTALLATION MEETINGS

- A. Division 1 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

#### 1.8 SEQUENCING

- A. Division 1 - Summary: Work sequence.
- B. Sequence balancing between completion of systems tested and Date of Substantial Completion.

#### 1.9 SCHEDULING

- A. Division 1 - Administrative Requirements: Coordination and project conditions.
- B. Schedule and provide assistance in final adjustment and test of smoke control system with Fire Authority.

## 2PART PRODUCTS

Not Used.

## 3PART EXECUTION

### 3.1 EXAMINATION

- A. Division 1 - Administrative Requirements: Coordination and project conditions.
- B. Verify systems are complete and operable before commencing work. Verify the following:
  - 1. Systems are started and operating in safe and normal condition.
  - 2. Temperature control systems are installed complete and operable.
  - 3. Proper thermal overload protection is in place for electrical equipment.
  - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
  - 5. Duct systems are clean of debris.
  - 6. Fans are rotating correctly.
  - 7. Fire and volume dampers are in place and open.
  - 8. Air coil fins are cleaned and combed.
  - 9. Access doors are closed and duct end caps are in place.
  - 10. Air outlets are installed and connected.
  - 11. Duct system leakage is minimized and sealed.
  - 12. Hydronic systems are flushed, filled, and vented. No leaking
  - 13. Pumps are rotating correctly.
  - 14. Proper strainer baskets are clean and in place or in normal position.
  - 15. Service and balancing valves are open.

### 3.2 PREPARATION

- A. Furnish instruments required for testing, adjusting, and balancing operations.
- B. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

### 3.3 INSTALLATION TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 10 percent of design.
- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
- C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

### 3.4 ADJUSTING

- A. Division 1 - Execution Requirements: Testing, adjusting, and balancing.
- B. Verify recorded data represents actual measured or observed conditions.

- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.
- E. Report defects and deficiencies noted during performance of services, preventing system balance.
- 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.
- G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Owner.
- H. Check and adjust systems approximately six months after final acceptance and submit report.

### 3.5 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to obtain required or design supply, return, and exhaust air quantities.
- B. Make air quantity measurements in main ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts.
- E. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.
- F. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes to vary fan speed. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. At modulating damper locations, take measurements and balance at extreme conditions. Balance variable volume systems at maximum airflow rate, full cooling, and at minimum airflow rate, full heating.
- L. Measure building static pressure and adjust supply, return, and exhaust air systems to obtain required relationship between each to maintain approximately 0.08 inches positive static pressure near building entries. Reset barometric relief counterweight for required static pressure in buildings as required.



- M. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.
- N. For variable air volume system powered units set volume controller to airflow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable-air-volume temperature control.
- O. On fan powered VAV boxes, adjust airflow switches for proper operation.

### 3.6 WATER SYSTEM PROCEDURE

- A. Adjust water systems, after air balancing, to obtain design quantities.
- B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow-metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in system.
- C. Adjust systems to obtain specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Effect system balance with automatic control valves fully open or in normal position to heat transfer elements.
- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- F. Where available pump capacity is less than total flow requirements or individual system parts, simulate full flow in one part by temporary restriction of flow to other parts.

### 3.7 SCHEDULES

- A. Equipment Requiring Testing, Adjusting, and Balancing:
  - 1. Plumbing Pumps.
  - 2. HVAC Pumps.
  - 3. Air Cooled Water Chillers.
  - 4. Air Cooled Refrigerant Condensers.
  - 5. Roof Top Air Handling Units.
  - 6. Blower Coil Units.
  - 7. Air Compressor and Air Dryer.
  - 8. Air and Gas Regulators.
  - 9. Unit Ventilators.
  - 10. Fan Coil Units.
  - 11. Air Handling Units.
  - 12. Fans.
  - 13. Air Filters.
  - 14. Air Terminal Units.
  - 15. Air Inlets and Outlets.
  - 16. Hot Water Coils.
  - 17. Boilers.
  - 18. EMCS.

19. Barometric Relief Dampers.
20. Kitchen Hoods.

B. Report Forms

1. Title Page:
  - a. Name of Testing, Adjusting, and Balancing Agency
  - b. Address of Testing, Adjusting, and Balancing Agency
  - c. Telephone and facsimile numbers of Testing, Adjusting, and Balancing Agency
  - d. Project name
  - e. Project location
  - f. Project Architect
  - g. Project Engineer
  - h. Project Contractor
  - i. Project altitude
  - j. Report date
2. Summary Comments:
  - a. Design versus final performance
  - b. Notable characteristics of system
  - c. Description of systems operation sequence
  - d. Summary of outdoor and exhaust flows to indicate building pressurization
  - e. Nomenclature used throughout report
  - f. Test conditions
3. Instrument List:
  - a. Instrument
  - b. Manufacturer
  - c. Model number
  - d. Serial number
  - e. Range
  - f. Calibration date
4. Electric Motors:
  - a. Manufacturer
  - b. Model/Frame
  - c. HP/BHP and kW
  - d. Phase, voltage, amperage; nameplate, actual, no load
  - e. RPM
  - f. Service factor
  - g. Starter size, rating, heater elements
  - h. Sheave Make/Size/Bore
5. V-Belt Drive:
  - a. Identification/location
  - b. Required driven RPM
  - c. Driven sheave, diameter and RPM
  - d. Belt, size and quantity
  - e. Motor sheave diameter and RPM
  - f. Center to center distance, maximum, minimum, and actual
6. Pump Data:
  - a. Identification/number
  - b. Manufacturer
  - c. Size/model
  - d. Impeller
  - e. Service

- f. Design flow rate, pressure drop, BHP and kW
  - g. Actual flow rate, pressure drop, BHP and kW
  - h. Discharge pressure
  - i. Suction pressure
  - j. Total operating head pressure
  - k. Shut off, discharge and suction pressures
  - l. Shut off, total head pressure
7. Air Cooled Condenser:
- a. Identification/number
  - b. Location
  - c. Manufacturer
  - d. Model number
  - e. Serial number
  - f. Entering DB air temperature, design and actual
  - g. Leaving DB air temperature, design and actual
  - h. Number of compressors
8. Chillers:
- a. Identification/number
  - b. Manufacturer
  - c. Capacity
  - d. Model number
  - e. Serial number
  - f. Evaporator entering water temperature, design and actual
  - g. Evaporator leaving water temperature, design and actual
  - h. Evaporator pressure drop, design and actual
  - i. Evaporator water flow rate, design and actual
  - j. Condenser entering water temperature, design and actual
  - k. Condenser pressure drop, design and actual
  - l. Condenser water flow rate, design and actual
9. Cooling or Heating Coil Data:
- a. Identification/number
  - b. Location
  - c. Service
  - d. Manufacturer
  - e. Air flow, design and actual
  - f. Entering air DB temperature, design and actual
  - g. Entering air WB temperature, design and actual
  - h. Leaving air DB temperature, design and actual
  - i. Leaving air WB temperature, design and actual
  - j. Water flow, design and actual
  - k. Water pressure drop, design and actual
  - l. Entering water temperature, design and actual
  - m. Leaving water temperature, design and actual
  - n. Saturated suction temperature, design and actual
  - o. Air pressure drop, design and actual
10. Unit Ventilator and Fan Coil Data:
- a. Manufacturer
  - b. Identification/number
  - c. Location
  - d. Model number
  - e. Size

- f. Air flow, design and actual
  - g. Water flow, design and actual
  - h. Water pressure drop, design and actual
  - i. Entering water temperature, design and actual
  - j. Leaving water temperature, design and actual
  - k. Entering air temperature, design and actual
  - l. Leaving air temperature, design and actual
11. Air Moving Equipment:
- a. Location
  - b. Manufacturer
  - c. Model number
  - d. Serial number
  - e. Arrangement/Class/Discharge
  - f. Air flow, specified and actual
  - g. Return air flow, specified and actual
  - h. Outside air flow, specified and actual
  - i. Total static pressure (total external), specified and actual
  - j. Inlet pressure
  - k. Discharge pressure
  - l. Sheave Make/Size/Bore
  - m. Number of Belts/Make/Size
  - n. Fan RPM
12. Return Air/Outside Air Data:
- a. Identification/location
  - b. Design air flow
  - c. Actual air flow
  - d. Design return air flow
  - e. Actual return air flow
  - f. Design outside air flow
  - g. Actual outside air flow
  - h. Return air temperature
  - i. Outside air temperature
  - j. Required mixed air temperature
  - k. Actual mixed air temperature
  - l. Design outside/return air ratio
  - m. Actual outside/return air ratio
13. Exhaust Fan Data:
- a. Location
  - b. Manufacturer
  - c. Model number
  - d. Serial number
  - e. Air flow, specified and actual
  - f. Total static pressure (total external), specified and actual
  - g. Inlet pressure
  - h. Discharge pressure
  - i. Sheave Make/Size/Bore
  - j. Number of Belts/Make/Size
  - k. Fan RPM
14. Duct Traverse:
- a. System zone/branch
  - b. Duct size

- c. Area
  - d. Design velocity
  - e. Design air flow
  - f. Test velocity
  - g. Test air flow
  - h. Duct static pressure
  - i. Air temperature
  - j. Air correction factor
15. Duct Leak Test:
- a. Description of ductwork under test
  - b. Duct design operating pressure
  - c. Duct design test static pressure
  - d. Duct capacity, air flow
  - e. Maximum allowable leakage duct capacity times leak factor
  - f. Test apparatus
    - 1) Blower
    - 2) Orifice, tube size
    - 3) Orifice size
    - 4) Calibrated
  - g. Test static pressure
  - h. Test orifice differential pressure
  - i. Leakage
16. Air Monitoring Station Data: (on outside air delivery system to AHU's)
- a. Identification/location
  - b. System
  - c. Size
  - d. Area
  - e. Design velocity
  - f. Design air flow
  - g. Test velocity
  - h. Test air flow
17. Flow Measuring Station:
- a. Identification/number
  - b. Location
  - c. Size
  - d. Manufacturer
  - e. Model number
  - f. Serial number
  - g. Design Flow rate
  - h. Design pressure drop
  - i. Actual/final pressure drop
  - j. Actual/final flow rate
  - k. Station calibrated setting
18. Terminal Unit Data:
- a. Manufacturer
  - b. Type, constant, variable, single, dual duct
  - c. Identification/number
  - d. Location
  - e. Model number
  - f. Size
  - g. Minimum static pressure

- h. Minimum design air flow
  - i. Maximum design air flow
  - j. Maximum actual air flow
  - k. Inlet static pressure
19. Air Distribution Test Sheet:
- a. Air terminal number
  - b. Room number/location
  - c. Terminal type
  - d. Terminal size
  - e. Area factor
  - f. Design velocity
  - g. Design air flow
  - h. Test (final) velocity
  - i. Test (final) air flow
  - j. Percent of design air flow
20. Sound Level Report:
- a. Location
  - b. Octave bands - equipment off
  - c. Octave bands - equipment on
  - d. RC level - equipment on
21. Vibration Test:
- a. Location of points:
    - 1) Fan bearing, drive end
    - 2) Fan bearing, opposite end
    - 3) Motor bearing, center (when applicable)
    - 4) Motor bearing, drive end
    - 5) Motor bearing, opposite end
    - 6) Casing (bottom or top)
    - 7) Casing (side)
    - 8) Duct after flexible connection (discharge)
    - 9) Duct after flexible connection (suction)
  - b. Test readings:
    - 1) Horizontal, velocity and displacement
    - 2) Vertical, velocity and displacement
    - 3) Axial, velocity and displacement
  - c. Normally acceptable readings, velocity and acceleration
  - d. Unusual conditions at time of test
  - e. Vibration source (when non-complying)
22. Air (or Gas) Regulators
- a. Location
  - b. Inlet Pressure
  - c. Outlet Pressure
23. Boilers
- a. Identification number
  - b. Location
  - c. Service
  - d. Manufacturer
  - e. GPM flow rate, design and actual

- f.  $\Delta T$  across boiler, design and actual
- g. Enter water temperature, design and actual
- h. Leaving water temperature, design and actual
- i. Inlet pressure, actual
- j. Outlet pressure, actual
- k. Gas flow CFH, design and actual
- 24. Barometric Relief Dampers
  - a. Location/room
  - b. Air flow across dampers
  - c. Static pressure at face inlet
- 25. Kitchen Hoods
  - a. Hood identification
  - b. Supplies balancing damper positions
  - c. Air flow across exhaust and supply openings

END OF SECTION





## SECTION 23 07 00

### MECHANICAL INSULATION

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
1. Ductwork insulation.
  2. Duct liner.
  3. Insulation jackets.
  4. Equipment insulation
  5. Breeching insulation.
  6. Piping system insulation.
  7. Insulation accessories including vapor retarders, jackets, and accessories.
  8. Generator exhaust pipe.
- B. Related Sections:
1. Section 078400- Firestopping: Product requirements for firestopping for placement by this section.
  2. Section 099000 - Paints and Coatings: Execution requirements for painting insulation jackets and covering specified by this section.
  3. Section 230529 - Supports and Anchors: Product and Execution requirements for inserts at hanger locations.
  4. Section 230503 - Mechanical Identification: Product requirements for mechanical identification.

##### 1.2 REFERENCES

- A. ASTM International:
1. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
  2. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
  3. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
  4. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
  5. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
  6. ASTM C449/C449M - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
  7. ASTM C518 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
  8. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
  9. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
  10. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
  11. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation.

12. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
13. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
14. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type).
15. ASTM C610 - Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation.
16. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
17. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
18. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
19. ASTM C1071 - Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material).
20. ASTM C1126 - Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.
21. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
22. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
23. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
24. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
25. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
26. ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.
27. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

- B. Sheet Metal and Air Conditioning Contractors':
  1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

### 1.3 SUBMITTALS

- A. Section 01330 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.
- C. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

#### 1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Applicator: Company specializing in performing Work of this section with minimum three years experience.

#### 1.5 PRE-INSTALLATION MEETINGS

- A. Section 01300 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01600 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- C. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

#### 1.7 ENVIRONMENTAL REQUIREMENTS

- A. Section 01600 - Product Requirements: Environmental conditions affecting products on site.
- B. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.
- C. Maintain temperature during and after installation for minimum period of 24 hours.

#### 1.8 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

#### 1.9 WARRANTY

- A. Section 01700 - Execution Requirements: Product warranties and product bonds.
- B. Furnish five year manufacturer warranty for all mechanical insulation on project.

## 2 PART 2 PRODUCTS

### 2.1 MAN MADE MINERAL FIBER

- A. Insulation: ASTM C547 Mineral Fiber Pre-molded Pipe Insulation, Type I, 850 degrees F (454 degrees C).
- B. Insulation: ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
  - 1. 'K' ('ksi') factor: ASTM C177, 0.24 at 75 degrees F.
  - 2. Maximum service temperature: 650 degrees F.
  - 3. Maximum moisture absorption: 0.2 percent by volume.
- C. Vapor Retarder Jacket:
  - 1. ASTM C921, White Kraft paper with glass fiber yarn, bonded to aluminized film.
  - 2. Moisture vapor transmission: ASTM E96; 0.02 perm-inches.
- D. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.

### 2.2 GLASS FIBER, FLEXIBLE

- A. Insulation: ASTM C553; flexible, noncombustible blanket.
  - 1. 'K' ('ksi') value: ASTM C518, 0.31 at 75 degrees F.
  - 2. Maximum service temperature: 250 degrees F.
  - 3. Maximum moisture absorption: 0.20 percent by volume.
  - 4. 2 inch thick 3/4 lb. density minimum.
- B. Vapor Barrier Jacket:
  - 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
  - 2. Moisture vapor transmission: ASTM E96; 0.02 perm.
  - 3. Secure with pressure sensitive tape.
- C. Vapor Barrier Tape:
  - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive. To be sealed with fabric weave embedded with mastic sealant.
- D. Vapor Barrier Mastic (in Mechanical Rooms open to ambient):
  - 1. Vinyl emulsion type acrylic or mastic, compatible with insulation, white color.
  - 2. **Jacket not required in closed Mechanical Rooms open to ambient.**
- E. Tie Wire: Annealed stainless steel, 18 gage.

### 2.3 MAN MADE MINERAL FIBER, FLEXIBLE BLANKET OR BATTS

- A. Insulation: ASTM C1290; Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  - 1. Operating Temperatures: 250 degrees F (121 degrees C).
  - 2. Density: 0.75 lb/cu ft (12 kg/cu m), 2 inch thickness minimum.
  - 3. 'K' ('ksi') factor: ASTM C518, 0.30 at 75 degrees F.

- B. Vapor Retarder Jacket: **Kraft paper, glass fiber yarn and bonder to aluminized film.** ASTM 1136, Type II Flexible and Low Permeance Vapor Retarders for Thermal Insulation.
  - 1. For systems operating at temperatures below ambient, close and secure seams and joints. When outward clinching staples are used, seal penetrations.
  - 2. **Insulating Cement/Mastic: ASTM C195; hydraulic setting on all joints and seams.**
- C. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.
- D. Vapor Retarder Lap Adhesive:
  - 1. Compatible with insulation.
- E. Insulating Cement/Mastic:
  - 1. ASTM C195; hydraulic setting on ~~mineral wool~~ **all joints and seams.**

#### 2.4 MINERAL FIBER, FLEXIBLE

- A. Insulation: ASTM C553 Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications, Type II.
- B. Vapor Retarder Jacket:
  - 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
  - 2. Moisture vapor transmission: ASTM E96; 0.02 perm.
  - 3. Secure with pressure sensitive tape, fiber mesh embedded with mastic on all seams and joints over taping.
- C. Vapor Retarder Tape:
  - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
- D. Tie Wire: Annealed steel, 16 gage (1.5 mm).
- E. **All joints to be mastic covered.**

#### 2.5 CELLULAR GLASS (OUTSIDE DUCTWORK AND ALL CHILLED WATER PIPING)

- A. Insulation: ASTM C552, Type II - pipe and tubing insulation, Class 2 - Jacketed.
  - 1. 'K' ('ksi') factor: ASTM C177 or ASTM C518, 0.29 at 75 degrees F.

#### 2.6 GLASS FIBER, RIGID

- A. Insulation: ASTM C612 or ASTM C592; rigid, noncombustible.
  - 1. 'K' ('ksi') factor: ASTM C177 or ASTM C518, 0.24 at 75 degrees F.
  - 2. Maximum Service Temperature: 450 degrees F.
  - 3. Maximum Moisture Absorption: 0.1 percent by volume.
  - 4. Density: 3.0 ft.
- B. Vapor Retarder Jacket: ASTM C1136 Flexible, Low Permeance Vapor Retarders for Thermal Insulation, Type II.

- C. Facing: 1 inch (25 mm) stainless steel hexagonal wire mesh stitched on one face of insulation.
- D. Vapor Retarder Lap Adhesive:
  1. Compatible with insulation.
- E. Insulating Cement/Mastic:
  1. ASTM C195; hydraulic setting on mineral wool.

## 2.7 ELASTOMERIC CELLULAR FOAM PRE-MOLDED ON CONDENSATE PIPING

- A. Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular form: ASTM C534; Type I, Tubular form
- B. Elastomeric Foam Adhesive:
  1. Air dried, contact adhesive, compatible with insulation. 100% coverage required.
- C. Liner: Use elastomeric cellular foam in sheets of thickness specified for acoustical liner. Install smooth side towards air flow.

## 2.8 PIPE INSULATION AND EQUIPMENT JACKETS

- A. PVC Plastic Pipe Jacket: (in Mechanical Room and where exposed within Building)
  1. Product Description: ASTM D1784, One piece molded type fitting covers and sheet material, off-white color.
  2. Thickness: 15 mil.
  3. Connections: Brush on welding adhesive or pressure sensitive color matching vinyl tape.
- B. PVC Plastic Equipment Jacket Inside Building (Pumps, Tanks, Chiller Barrels, Valves):
  1. Product Description: PVC sheet material, off-white color.
  2. Minimum Service Temperature: -40 F.
  3. Maximum Service Temperature: 150 F.
  4. Moisture Vapor Transmission: ASTM E96; 0.002 perm-inches.
  5. Thickness: 15 mil.
  6. Connections: Brush on welding adhesive or pressure sensitive color matching vinyl tape.
- C. Covering Adhesive Mastic:
  1. Compatible with insulation, 100% glued on all contact surfaces.
- D. Aluminum Pipe Jacket: (Ambient Condition Exposure)
  1. ASTM B209 and/or ASTM B209M.
  2. Thickness: 0.025 inch thick sheet.
  3. Finish: Embossed.
  4. Joining: Longitudinal slip joints and 2 inch (50 mm) laps minimum.
  5. Fittings: .025 inch thick die shaped fitting covers with factory attached protective liner.
  6. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.010 inch thick stainless steel.

## 2.9 GLASS FIBER

- A. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
  - 1. 'K' ('Ksi') value: ASTM C177, 0.24 at 75 degrees F.
  - 2. Maximum service temperature: 850 degrees F.
  - 3. Maximum moisture absorption: 0.2 percent by volume.
- B. Insulation: ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
  - 1. 'K' ('Ksi') value: ASTM C177, 0.24 at 75 degrees F (0.035 at 24 degrees C).
  - 2. Maximum service temperature: 650 degrees F (343 degrees C).
  - 3. Maximum moisture absorption: 0.2 percent by volume.
- C. Vapor Barrier Jacket:
  - 1. ASTM C921, White kraft paper with glass fiber yarn, bonded to aluminized film.
  - 2. Moisture vapor transmission: ASTM E96; 0.02 perm-inches.
- D. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.
- E. Vapor Barrier Lap Adhesive:
  - 1. Compatible with insulation.
- F. Fibrous Glass Fabric:
  - 1. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight.
  - 2. Blanket: 1.0 lb/cu ft (16 kg/cu m) density.
  - 3. Weave: 5x5.
- G. Indoor Vapor Barrier Finish:
  - 1. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight.
  - 2. Vinyl emulsion type acrylic, compatible with insulation, white color.

## 3PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Section 01300 - Administrative Requirements: Coordination and project conditions.
- B. Verify piping, equipment and ductwork has been tested before applying insulation materials.
- C. Verify surfaces are clean and dry, with foreign material removed.

### 3.2 INSTALLATION

- A. Exposed Piping: Locate insulation and cover seams in least visible locations.
- B. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints. Provide premanufactured removable insulation assemblies on pumps, strainers and other equipment needing periodic maintenance.

- C. Man made mineral fiber insulated pipes conveying fluids below ambient temperature:
1. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
  2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor retarder adhesive or PVC fitting covers.
- D. For hot piping conveying fluids over 100 degrees F, insulate flanges and unions at equipment.
- E. Man made mineral fiber insulated pipes conveying fluids above ambient temperature:
1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
  2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers in all exposed areas.
- F. Inserts and Shields:
1. Application: Piping or Equipment 1-1/2 inches diameter or larger.
  2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
  3. Insert location: Between support shield and piping and under finish jacket.
  4. Insert configuration: Minimum 6 inches (150 mm) long, of thickness and contour matching adjoining insulation; may be factory fabricated.
  5. Insert material: Compression resistant insulating material suitable for planned temperature range and service.
- G. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Section 07840 for penetrations of assemblies with fire resistance rating greater than one hour.
- H. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces: Finish with PVC jacket and fitting covers.
- I. Exterior Applications: Provide vapor retarder jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor retarder cement. Cover with aluminum jacket with seams located at 3 or 9 o'clock position on side of horizontal piping with overlap facing down to shed water or on bottom side of horizontal equipment.
- J. Buried Piping: Insulate only with cellular glass for both cold and hot with pittwrap on both. Install factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with 1 mil (0.025 mm) thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with polyester film. Pre insulated systems with poly and Schedule 40 PVC jacket or approved equal.
- K. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size insulation large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located at 3 or 9 o'clock position on side of horizontal piping with



overlap facing down to shed water. Insulation must have same pittwrap factory fabricated assembly as stated above.

- L. Factory Insulated Equipment: Do not insulate.
- M. Exposed Equipment, Tanks, Pumps, and Valves: Locate insulation and cover seams in least visible locations.
- N. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
- O. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.
- P. Insulated equipment containing fluids below ambient temperature: Insulate entire system.
- Q. For hot equipment containing fluids over 140 degrees F, insulate flanges and unions with removable sections and jackets.
- R. Mineral fiber insulated equipment containing fluids above ambient temperature: Provide standard jackets, with or without vapor retarder, factory-applied or field-applied. Finish with glass cloth and adhesive.
- S. Finish insulation at supports, protrusions, and interruptions.
- T. Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting on air handling units; PVC jacket and fitting covers or aluminum jacket on piping, tanks, pumps, etc.
- U. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.
- V. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation for easy removal and replacement without damage. Provide premanufactured assemblies specifically manufactured for such device and purpose.
- W. Insulated ductwork conveying air below ambient temperature:
  - 1. Provide insulation with vapor retarder jackets.
  - 2. Finish with tape and vapor retarder jacket and sealed with fiber mesh and sealer.
  - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
  - 4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints. Mastic all joints, seams and terminations with fiber mesh and sealant.
- X. Insulated ductwork conveying air above ambient temperature:
  - 1. Provide with standard vapor retarder jacket.
  - 2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

- Y. Ductwork Exposed in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting or aluminum jacket.
- Z. Exterior Applications: Provide insulation with vapor retarder jacket. Cover with caulked aluminum jacket with seams located on bottom side of horizontal duct section.
- AA. External Duct Insulation Application:
  - 1. Secure insulation with vapor retarder with wires and seal jacket joints with vapor retarder adhesive or tape to match jacket.
  - 2. Secure insulation without vapor retarder with staples, tape, or wires.
  - 3. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.
  - 4. Seal vapor retarder penetrations by mechanical fasteners with vapor retarder adhesive.
  - 5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
  - 6. Provide outer covering of aluminum jacket that is mastic sealed at all joints.
- BB. Duct and Plenum Liner Application:
  - 1. Adhere insulation with adhesive for 100 percent coverage.
  - 2. Secure insulation with mechanical liner fasteners. SMACNA Standards for spacing. Maximum spacing 12 inches on centers and 3 inches from corners and edges.
  - 3. Seal and smooth joints. Seal and coat transverse joints.
  - 4. Seal liner surface penetrations with adhesive.
  - 5. Duct dimensions indicated are net inside dimensions required for airflow. Increase duct size to allow for insulation thickness.

### 3.3 SCHEDULES

- A. Plumbing Systems:
  - 1. Domestic Hot Water Supply:
    - a. Man Made Mineral Fiber Insulation:
      - 1) Pipe Size Range: All.
      - 2) Thickness: 1 inch.
    - b. Cellular Glass Insulation:
      - 1) Pipe Size Range: All.
      - 2) Thickness: 3 inch; ambient exposure; 2" buried and inside building and Mechanical Rooms.
    - c. Cellular Elastomeric Foam Insulation:
      - 1) Pipe Size Range: All.
      - 2) Thickness: 1 inch.
  - 2. Domestic Hot Water Re-circulation:
    - a. Man Made Mineral Fiber Insulation:
      - 1) Pipe Size Range: All sizes.
      - 2) Thickness: 1 inch (25 mm).
    - b. Expanded Polyethylene Insulation:
      - 1) Pipe Size Range: All sizes.
      - 2) Thickness: 1 inch (25 mm).

- c. Cellular Foam Insulation:
  - 1) Pipe Size Range: All sizes.
  - 2) Thickness: 1 inch (25 mm)
- 3. Domestic Cold Water: 1 inch when exposed to freezing temperatures.
- 4. Roof Drain Bodies: 1 inch.
- 5. Roof Drainage Within 10 feet (3 Meters) of Exterior: 1 inch.
- 6. Plumbing Vents Within 10 feet (3 Meters) of Exterior: 1 inch.
- 7. Chilled Drinking Water Supply: 1 inch.
- B. Cooling Systems:
  - 1. Chilled Water: 3 inch cellular ambient and buried. 2 inch inside building.
  - 2. Cold Condensate Drains: 1 inch.
  - 3. Condensate Drains from Cooling Coils: 1 inch.
- C. Other Systems:
  - 1. Piping Exposed to Freezing with Heat Tracing: 3 inch cellular (chiller yard)
- D. Plumbing Systems:
  - 1. Domestic Hot Water Storage Tanks:
    - a. Mineral Fiberboard Insulation: 4 inch thick.
    - b. Cellular Glass Insulation: 3 inch thick.
    - c. Hydrous Calcium Silicate Insulation: 2 inches thick.
    - d. Cellular Foam Insulation: 2 inch thick.
  - 2. Heating Systems:
    - a. Pump Bodies: Same as piping.
    - b. Air Separators: Same as piping.
    - c. Expansion Tanks: Same as piping.
    - d. Hot Thermal Storage Tanks: Same as piping.
  - 3. Cooling Systems:
    - a. Pump Bodies: Same as piping.
    - b. Air Separators: Same as piping.
    - c. Expansion Tanks: Same as piping.
    - d. Chiller Cold Surfaces: 2 inch cellular foam with aluminum jacket.
    - e. Cold Thermal Storage Tanks: Same as piping.
    - f. Equipment Exposed to Freezing without Heat Tracing: Same as piping.
    - g. Ductwork in Mechanical Rooms – 2" rigid fiberglass, foil faced.
    - h. Exposed ductwork 2" rigid fiberglass, foil faced.
- E. Exhaust Ducts within 10 feet (3 m) of Exterior Openings: 2 inches.
- F. Exhaust Ducts Exposed to Outdoor Air: 3 inch.
- G. Outside Air Intake Ducts: 2 inch.
- H. Plenums: 2 inch.
- I. Plenums (Cooling System): 2 inch.
- J. Supply Ducts: 2 inch.

- K. Supply ducts After Terminal Boxes: 2 inch.
- L. Return and Relief Ducts in Mechanical Rooms: 2 inch.
- M. Ducts Exposed to Outdoors: 2 inch cellular foam with aluminum jacket.

END OF SECTION

SECTION 23 21 13  
HYDRONIC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe and pipe fittings for:
  - 1. Chilled and hot water piping system.
  - 2. Equipment drains and overflows.
  
- B. Valves:
  - 1. Globe or angle valves.
  - 2. Ball valves.
  - 3. Plug valves.
  - 4. Butterfly valves.
  - 5. Check valves.

1.2 RELATED SECTIONS

- A. Section 230503 - Mechanical Identification.
- B. Section 232116 - Hydronic Specialties.
- C. Division 26 - Equipment Wiring Systems: Electrical characteristics and wiring connections.

1.3 REFERENCES

- A. ASME - Boiler and Pressure Vessel Codes, SEC 9 - Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.
- B. ASME B16.3 - Malleable Iron Threaded Fittings Class 50 and 300.
- C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- D. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- E. ASME B31.5 - Refrigeration Piping.
- F. ASME B31.9 - Building Services Piping.
- G. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
- H. ASTM A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- I. ASTM B32 - Solder Metal.

- J. ASTM B88 - Seamless Copper Water Tube.
- K. ASTM D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- L. ASTM D2235 - Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
- M. ASTM D2241 - Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR-Series).
- N. ASTM D2310 - Machine-Made Reinforced Thermosetting Resin Pipe.
- O. ASTM D2466 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- P. ASTM D2467 - Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- Q. ASTM D2680 - Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite-Sewer Piping.
- R. ASTM D2683 - Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
- S. ASTM D2751 - Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.
- T. ASTM D2855 - Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
- U. ASTM D3309 - Polybutylene (PB) Plastic Hot-and Cold-Water Distribution Systems.
- V. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- W. ASTM F708 - Design and Installation of Rigid Pipe Hangers.
- X. ASTM F845 - Plastic Insert Fittings for Polybutylene (PB) Tubing.
- Y. ASTM F876 - Crosslinked Polyethylene (PEX) Tubing.
- Z. ASTM F877 - Crosslinked Polyethylene (PEX) Plastic Hot - and Cold - Water Distribution Systems.
- AA. AWS A5.8 - Brazing Filler Metal.
- BB. AWS D1.1 - Structural Welding Code.
- CC. AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.
- DD. AWWA C110 - Ductile - Iron and Grey -Iron Fittings 3 in. through 48 in., for Water and Other Liquids.
- EE. AWWA C111 - Rubber-Gasket Joints for Ductile Iron and Grey-Iron Pressure Pipe and Fittings.
- FF. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.

- GG. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacture.
- HH. MSS SP69 - Pipe Hangers and Supports - Selection and Application.
- II. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

#### 1.4 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- B. Only use grooved mechanical couplings and fasteners in accessible locations and at all equipment connections.
- C. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.
- D. Use non-conducting dielectric connections whenever jointing dissimilar metals in open systems.
- E. Provide pipe hangers and supports in accordance with ASTM B31.9 unless indicated otherwise.
- F. Use ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- G. Use globe, ball or butterfly valves for throttling, bypass, or manual flow control services.
- H. Use plug cocks for throttling service. Use non-lubricated plug cocks only when shut-off or isolating valves are also provided.
- I. Use butterfly valves in chilled and in heating water systems, interchangeably with gate and globe valves.
- J. Use only butterfly valves in chilled water systems for throttling and isolation service, for pipe sizes over 2 inches. Otherwise use ball valves.
- K. Use lug end butterfly valves to isolate equipment.
- L. Use 3/4 inch (20 mm) ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.

#### 1.5 SUBMITTALS

- A. Product Data: Include data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.
- B. Welders Certificate: Include welder's certification of compliance with ASME SEC 9.
- C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

1.6 PROJECT RECORD DOCUMENTS

- A. Record actual locations of valves and buried piping. Provide thrust block layout.

1.7 OPERATION AND MAINTENANCE DATA

- A. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing the work of this section with minimum three years experience.
- C. Welders: Certify in accordance with ASME SEC 9.

1.9 REGULATORY REQUIREMENTS

- A. Conform to ASME B31.9 code for installation of piping system.
- B. Welding Materials and Procedures: Conform to ASME SEC 9 and applicable state labor regulations.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.11 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

1.12 EXTRA MATERIALS

- A. Provide two repacking kits for each size and valve type.



## 2 PART2 PRODUCTS

### 2.1 CHILLED WATER PIPING, BURIED

- A. Steel Pipe: ASTM A53, Schedule 80, black with AWWA C105 polyethylene jacket, or double layer, half-lapped 10 mil (0.25 mm) polyethylene tape.
1. Fittings: ASTM A234, forged steel welding type with double layer, half-lapped 10 mil (0.25 mm) polyethylene tape.
  2. Joints: AWS D1.1, welded.
  3. ~~Casing: See Section 15080.~~ **Casing: see insulation specification or shall be PVC, HDPE or non corrosive casing for area install.**
- B. Aquatherm chilled/hot water piping type SDR7.4MF or SRD 11 Fusion PR-R Fraser composite may be utilized. ASTM F2389 may be utilized. Minimum working pressure for chilled water @ 45 degrees F shall be 195 PSIG, for hot water shall be 100 PSIG @ 180 degrees F @ a 60 year life cycle for both. All fitting shall be factory manufactured and molded. Piping shall be embedded and covered with a 6" layer of clean backfill and tamped. Due to expansion coefficient of material, allow for expansion and construct expansion loops as recommended by manufacturer. However, provide a minimum of expansion loops indicated on mechanical plans or more were required by manufacturer.
- C. **Allowable products of ISCO polypropylene, Niron or equal may be substituted when in compliance specification listed in Paragraph A above and intended use.**
- D. **It is recommended that all underground hot water piping be pre-insulated with PVC, HDPE or allowable jacket. Chilled water if the carrier pipe is a poly material may be installed as direct burial with no jacket or insulation.**
- E. **All underground no metal pipe or jacket shall be traced with #10 gage stainless steel wire 12" below grade along path of piping system.**

### 2.2 CHILLED WATER PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53, Schedule 40, black for all sizes 4 inches and larger. Below 4 inches, use ASTM B88, copper type "K" piping ~~propress~~ **Propress** or Schedule 40 black iron.
1. Fittings: Use criteria for underground piping for sizes 4 inches and above. Otherwise, fittings shall be ASME 16.22, copper type "K" flanged or silver solder type.
  2. Joints: Flanged or silver solder connections for sizes below 4 inches. For sizes 4 inches and above, use criteria outlined for underground piping.

### 2.3 EQUIPMENT DRAINS AND OVERFLOWS

- A. Copper Tubing: ASTM B88, Type K, hard drawn.
1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
  2. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F (220 to 280 degrees C).

### 2.4 UNIONS, FLANGES, AND COUPLINGS

- A. Unions for Pipe 2 Inches (50 mm) and Under:
  1. Ferrous Piping: 150 psig (1034 kPa) malleable iron, threaded.
- B. Flanges for Pipe Over 2 Inches (50 mm):
  1. Ferrous Piping: 150 psig (1034 kPa) forged steel, slip-on.
  2. Gaskets: 1/16 inch (1.6 mm) thick preformed neoprene.
- C. Grooved and Shouldered Pipe End Couplings:
  1. Housing Clamps: Malleable iron galvanized to engage and lock, designed to permit some angular deflection, contraction, and expansion.
  2. Sealing Gasket: C-shape elastomer composition for operating temperature range from -30 degrees F to 230 degrees F.
  3. Accessories: Steel bolts, nuts, and washers.
- D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

## 2.5 GLOBE OR ANGLE VALVES

- A. Up To and Including 2 Inches (50 mm):
  1. Bronze body, bronze trim, screwed bonnet, rising stem and handwheel, inside screw, renewable plug disc and stainless steel seat ring, threaded ends.
- B. Over 2 Inches (50 mm):
  1. Iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, rotating plug-type disc with renewable seat ring and disc, flanged ends.

## 2.6 BALL VALVES

- A. Up To and Including 2 Inches (50 mm):
  1. Bronze two piece body, stainless steel ball, teflon seats and stuffing box ring, lever handle with balancing stops, threaded ends with union.
- B. Over 2 Inches (50 mm):
  1. Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, flanged.

## 2.7 PLUG VALVES

- A. Up To and Including 2 Inches (50 mm):
  1. Bronze body, bronze tapered plug, full port opening, non-lubricated, teflon packing, threaded ends.
  2. Operator: One plug valve wrench for every ten plug valves minimum of one.
- B. Over 2 Inches (50 mm):
  1. Cast iron body and plug, full port opening, pressure lubricated, teflon packing, flanged ends.
  2. Operator: Each plug valve with a wrench with set screw.

## 2.8 BUTTERFLY VALVES

- A. Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer or lug ends, extended neck.
- B. Disc: Stainless steel.
- C. Operator: Infinite position lever handle with memory stop.

## 2.9 SWING CHECK VALVES

- A. Up To and Including 2 Inches (50 mm):
  - 1. Bronze body, bronze trim, bronze rotating swing disc, with composition disc, threaded ends.
- B. Over 2 Inches (50 mm):
  - 1. Iron body, bronze trim, bronze or bronze faced rotating swing disc, renewable disc and seat, flanged ends.

## 3PART 3 EXECUTION

### 3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- E. After completion, fill, clean, and treat systems.

### 3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install heating water, chilled water, and engine exhaust piping to ASME B31.9.
- C. Route piping in orderly manner, parallel to building structure, and maintain gradient.
- D. Install piping to conserve building space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Sleeve pipe passing through partitions, walls and floors.
- G. Slope piping and arrange to drain at low points.
- H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected

equipment.

- I. Inserts:
  - 1. Provide inserts for placement in concrete formwork.
  - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
  - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 mm).
  - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
  - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.
  
- J. Pipe Hangers and Supports:
  - 1. Install in accordance with ASTM B31.9.
  - 2. Support horizontal piping as required to prevent sagging.
  - 3. Install hangers to provide minimum 1/2 inch (13 mm) space between finished covering and adjacent work.
  - 4. Place hangers within 12 inches (300 mm) of each horizontal elbow.
  - 5. Use hangers with 1-1/2 inch (38 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
  - 6. Support riser piping independently of connected horizontal piping.
  - 7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
  - 8. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
  
- K. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
  
- L. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Architect/Engineer.
  
- M. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
  
- N. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
  
- O. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting.
  
- P. Install valves with stems upright or horizontal, not inverted.
  
- Q. Pressure test all chilled water and hot water piping systems to 1-1/2 times operating pressure prior to trench backfill. In the event of a leak, drain system, clean and dry piping at point of leak. Repair piping and re-test.

END OF SECTION

SECTION 23 21 16  
HYDRONIC SPECIALITIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Expansion tanks.
- B. Air vents.
- C. Air separators.
- D. Strainers.
- E. Pump suction fittings.
- F. Combination fittings.
- G. Flow indicators, controls, meters.
- H. Relief valves.

1.2 RELATED SECTIONS

- A. Section 232113- Hydronic Piping.

1.3 REFERENCES

- A. ASME - Boilers and Pressure Vessel Codes, SEC 8-D-Rules for Construction of Pressure Vessels.

1.4 SUBMITTALS

- A. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description, model.
- B. Submit inspection certificates for pressure vessels from authority having jurisdiction.
- C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

1.5 PROJECT RECORD DOCUMENTS

- A. Record actual locations of flow controls, flow meters and valves.

1.6 OPERATION AND MAINTENANCE DATA

- A. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

## 1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years experience.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

## 1.9 MAINTENANCE SERVICE

- A. Furnish service and maintenance of system for one year from date of substantial completion.
- B. Monthly visit to make glycol fluid concentration analysis on site with refractive index measurement instrument. Detail findings with maintenance personnel in writing of corrective actions needed including analysis and amounts of glycol or water added.

## 2 PART PRODUCTS

### 2.1 DIAPHRAGM-TYPE EXPANSION TANKS (BLADDER TYPE)

- A. Taco, Model CA or equal.
- B. Construction: Welded steel, tested and stamped in accordance with ASME SEC 8-D; supplied with National Board Form U-1, rated for working pressure of 125 psig (860 kPa), with flexible butyl diaphragm sealed into tank.
- C. Accessories: Pressure gage and air-charging fitting, tank drain; precharge to 12 psig.
- D. Automatic Cold Water Fill Assembly: Pressure reducing valve, double check back flow preventer, test cocks, strainer, vacuum breaker, and valved by-pass.
- E. Size:
  - 1. Capacity: See Mechanical Schedules.

### 2.2 AIR VENTS

- A. Manual Type: Short vertical sections of 2 inch (50 mm) diameter pipe to form air chamber, with 1/8 inch (3 mm) brass needle valve at top of chamber. Install in non-accessible or above finished spaces.
- B. Automatic air vents shall be installed in Mechanical spaces only, unfinished spaces or outside.

## 2.3 AIR SEPARATORS

- A. Taco, Model ACF or equal.
- B. Dip Tube Fitting:
  - 1. For 125 psig (860 kPa) operating pressure; to prevent free air collected in boiler from rising into system.
- C. In-line Air Separators:
  - 1. Cast iron for sizes 1-1/2 inch (40 mm) and smaller, or steel for sizes 2 inch (50 mm) and larger; tested and stamped in accordance with ASME SEC 8-D; for 125 psig (860 kPa) operating pressure.
- D. Combination Air Separators/Strainers:
  - 1. Steel, tested and stamped in accordance with ASME SEC 8-D; for 125 psig (860 kPa) operating pressure, with integral bronze strainer, tangential inlet and outlet connections, and internal stainless steel air collector tube.

## 2.4 STRAINERS

- A. Size 2 inch (50 mm) and Under:
  - 1. Screwed brass or iron body for 175 psig (1200 kPa) working pressure, Y pattern with 1/32 inch (0.8 mm) stainless steel perforated screen.
- B. Size 2-1/2 inch (65 mm) to 4 inch (100 mm):
  - 1. Flanged iron body for 175 psig (1200 kPa) working pressure, Y pattern with 3/64 inch (1.2 mm) stainless steel perforated screen.
- C. Size 5 inch (125 mm) and Larger:
  - 1. Flanged iron body for 175 psig (1200 kPa) working pressure, basket pattern with 1/8 inch (3.2 mm) stainless steel perforated screen.

## 2.5 PUMP SUCTION FITTINGS

- A. Fitting: Angle pattern, cast-iron body, threaded for 2 inch (50 mm) and smaller, flanged for 2-1/2 inch (65 mm) and larger, rated for 175 psig (1200 kPa) working pressure, with inlet vanes, cylinder strainer with 3/16 inch (5 mm) diameter openings, disposable fine mesh strainer to fit over cylinder strainer, and permanent magnet located in flow stream and removable for cleaning.
- B. Accessories: Adjustable foot support, blowdown tapping in bottom, gage tapping in side.

## 2.6 COMBINATION PUMP DISCHARGE VALVES

- A. Valves: Straight or angle pattern, flanged cast-iron valve body with bolt-on bonnet for 175 psig (1200 kPa) operating pressure, non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, and calibrated adjustment permitting flow regulation.

## 2.7 FLOW CONTROLS

- A. Construction: Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet.
- B. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psig.
- C. Control Mechanism: Stainless steel or nickel plated brass piston or regulator cup, operating against stainless steel helical or wave formed spring.
- D. Accessories: In-line strainer on inlet and ball valve on outlet.

## 2.8 RELIEF VALVES

- A. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

## 3 PART EXECUTION

### 3.1 INSTALLATION

- A. Install specialties in accordance with manufacturer's instructions.
- B. Where large air quantities can accumulate, provide enlarged air collection standpipes.
- C. Provide manual air vents at system high points and as indicated.
- D. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.
- E. Provide air separator on suction side of system circulation pump and connect to expansion tank on primary pumping system only.
- F. Provide valved drain and hose connection on strainer blow down connection.
- G. Provide pump suction fitting on suction side of base mounted centrifugal pumps. Remove temporary strainers after cleaning systems.
- H. Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps.
- I. Support pump fittings with floor mounted pipe and flange supports.
- J. Provide radiator valves on water inlet to terminal heating units such as radiation, unit heaters, and fan coil units.
- K. Provide radiator balancing valves on water outlet from terminal heating units such as unit heaters and fan coil units.



- L. Provide relief valves on pressure tanks, low pressure side of reducing valves, and expansion tanks.
- M. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.
- N. Pipe relief valve outlet to nearest floor drain.
- O. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

END OF SECTION



## SECTION 23 21 18

### GAGES AND METERS

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Pressure gages and Pressure gage taps.
- B. Thermometers and thermometer wells.
- C. Filter gages.

##### 1.2 RELATED SECTIONS

- A. Section 232113 - Hydronic Piping: Installation of Thermometer wells and pressure gage tappings.

##### 1.3 REFERENCES

- A. ASME - B40.1 - Gages - Pressure Indicating Dial Type - Elastic Element.
- B. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle and Venturi.
- C. ASTM E1 - Specification for ASTM Thermometers.
- D. ASTM E77 - Verification and Calibration of Liquid-in-Glass Thermometers.

##### 1.4 SUBMITTALS FOR REVIEW

- A. Product Data: Provide list which indicates use, operating range, total range and location for manufactured components.

##### 1.5 SUBMITTALS AT PROJECT CLOSEOUT

- A. Operation and Maintenance Data Warranties and Bonds.
- B. Project Record Documents: Record actual locations of components and instrumentation.
- C. Operation and Maintenance Data.

##### 1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

## 2 PART PRODUCTS

### 2.1 LIQUID FLOW METERS

- A. Calibrated venturi orifice plate and flanges with valved taps, chart for conversion of differential pressure readings to flow rate, with pressure gage in case.
- B. Provide one (1) on each building secondary pump discharge, chiller and boiler.

### 2.2 PRESSURE GAGES

- A. Gage: ASME B40.1, drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
- B. Case: Steel with brass bourdon tube.
- C. Size: 4-1/2 inch diameter.
- D. Mid-Scale Accuracy: two percent.
- E. Scale: Psi.

### 2.3 PRESSURE GAGE TAPPINGS

- A. Gage Cock: Tee or lever handle, brass for maximum 150 psig.

### 2.4 STEM TYPE THERMOMETERS

- A. Thermometer: ASTM E1, adjustable angle, red appearing liquid, lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device.
- B. Size: 9 inch (225 mm) scale.
- C. Window: Clear glass.
- D. Stem: 3/4 inch (20 mm) NPT brass.
- E. Accuracy: ASTM E77 2 percent.
- F. Calibration: Degrees F.

### 2.5 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems.

### 2.6 TEST PLUGS

- A. Manufacturer: Basis of Design: Petes Plug.

- B. Test Plug: 1/4 inch (6 mm) or 1/2 inch (13 mm) brass fitting and cap for receiving 1/8 inch (3 mm) outside diameter pressure or temperature probe with Nordel core for temperatures up to 350 degrees F.
- C. Test Kit: Carrying case, internally padded and fitted containing one 2-1/2 inch (60 mm) diameter pressure gages, one gage adapters with 1/8 inch (3 mm) probes, two one inch (25 mm) 1-1/2 inch (38 mm) dial thermometers.

## 2.7 STATIC PRESSURE GAGES

- A. Manufacturer: Basis of Design: Dwyer, filter gage with flag.
- B. 3-1/2 inch (90 mm) diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.
- C. Inclined manometer, red liquid on white background with black figures, front recalibration adjustment, 3 percent of full scale accuracy.
- D. Accessories: Static pressure tips with compression fittings for bulkhead mounting, 1/4 inch (6 mm) diameter tubing.

## 3 PART EXECUTION

### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide three pressure gages per pump, installing taps before strainers and on suction and discharge of pump. Pipe to each gage.
- C. Provide gage cock to isolate each gage. Extend nipples to allow clearance from insulation.
- D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch (60 mm) for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- E. Install thermometers in air duct systems on flanges.
- F. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets. Where thermometers are provided on local panels, duct or pipe mounted thermometers are provided on local panels, duct or pipe mounted thermometers are not required.
- G. Coil and conceal excess capillary on remote element instruments.
- H. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- I. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- J. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

- K. Locate test plugs adjacent thermometers and thermometer sockets adjacent to pressure gages and pressure gage taps.
- L. Install pressure gages across all filter, coil, and fan sections on all systems.

### 3.2 SCHEDULES

#### A. Flow Meter Schedule

##### LOCATION

Heating water system  
Chiller water system  
Pumps, chillers, and boilers

#### B. Pressure Gage Schedule

##### LOCATION

Pumps  
Chillers - supply  
AHU's coils, chilled and hot water  
Fan Sections  
Boilers  
Gas Regulator and Gas Manifolds  
Air Regulator and Air Manifolds

#### C. Pressure Gage Tapping Schedule

##### LOCATION

Control valves 3/4 inch (20 mm) & larger - inlets and outlets  
Major coils - inlets and outlets  
Chiller - inlets and outlets  
Boiler - inlets and outlets

#### D. Stem Type Thermometer Schedule

##### LOCATION

Headers to central equipment  
Coils and coil banks - inlets and outlets  
Boiler - inlet and outlet  
Chiller - inlet and outlet  
Domestic hot water supply and recirculation

E. Thermometer Socket Schedule

LOCATION

Control valves 1 inch (25 mm) & larger - inlets and outlets  
Reheat coils - inlets and outlets

F. Dial Thermometer Schedule

LOCATION

Each supply air zone  
Outside air  
Return air  
Mixed air

G. Static Pressure and Filter Gage Schedule

LOCATION

Built up filter banks  
Unitary filter sections  
Supply fan discharge  
Coil sections

END OF SECTION





## SECTION 23 22 16

### CONDENSATE DRAIN PIPING

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Scope: Provide condensate drain piping from cooling coil drain pans. Drain piping shall be routed to the nearest floor drain except as otherwise indicated on the drawings.
- B. Related Sections: Refer to other Division 23 sections for the following:
  - 1. Section 230503 - Mechanical Identification.
- C. Other Divisions: Refer to other Divisions of the specification for the following:
  - 1. Field Painting: Division 9.
  - 2. Piping systems requiring fixed locations and slopes shall have priority over those which do not have both requirements.

##### 1.2 QUALITY ASSURANCE

- A. Codes and Standards: Provide piping and fittings conforming to the requirements of the following:
  - 1. American Society for Testing and Materials (ASTM):
    - a. B16.22 Standard Specification for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
    - b. B16.23 Standard Specification for Cast Solder Fittings
    - c. B16.29 Standard Specification for Wrought Solder Fittings
    - d. B88 Standard Specification for Seamless Copper Water Tube
    - e. B306 Standard Specification for Seamless Copper Waste and Vent Pipe

##### 1.3 SUBMITTALS

- A. Division 1: Refer to "Submittals" for basic information relating to submittal requirements.
- B. Product Data: Submit manufacturer's standard technical product data indicating conformance to the stipulated reference specifications, construction materials, construction details, and test and operating pressures. Submit manufacturer's product data on the following:
  - 1. Pipe materials.

##### 1.4 STORAGE AND PROTECTION

- A. Storage: Store piping on the project site so as to preclude the entrance of construction dirt and debris into the open ends of piping. Do not install piping fouled with construction dirt.
- B. Storage of Fittings: Store fittings under cover, protected from construction dirt and rain.

## 2 PART PRODUCTS

### 2.1 PIPING MATERIALS

- A. Piping shall be copper type 'K' as specified.

## 3PART EXECUTION

### 3.1 GENERAL

- A. Piping shall be sloped uniformly toward floor drain and provided with trap seal having a depth, in inches, equivalent to the total static pressure of the respective fan system plus two inches.
- B. Piping shall be installed in a neat and workmanlike manner and shall not be smaller than full size of the equipment drain connection or one-half inch (1/2") whichever is larger.
- C. Unless otherwise noted on Drawings, use copper type "K" for condensate line material.

### 3.2 INSTALLATION

- A. Sizes: Provide piping systems of sizes indicated on the drawings. Systems shall be installed complete.
- B. Codes: Install piping systems in conformance with all applicable codes.
- C. Pitch: Install condensate drain piping with a pitch or slope of not less than 1/8 inch per foot in the direction of flow.

### 3.3 ROUTING

- A. Unless otherwise indicated, route pipe discharge to the nearest hub drain.

END OF SECTION

## SECTION 23 23 00

### REFRIGERANT PIPING

#### PART 1 GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Refrigerant piping.
2. Unions, flanges, and couplings.
3. Pipe hangers and supports.
4. Refrigerant moisture and liquid indicators.
5. Valves.
6. Refrigerant strainers.
7. Refrigerant pressure regulators.
8. Refrigerant pressure relief valves.
9. Refrigerant filter-driers.
10. Refrigerant solenoid valves.
11. Refrigerant expansion valves.
12. Electronic expansion valves.
13. Refrigerant receivers.
14. Underground pipe markers.
15. Bedding and cover materials.

###### B. Related Sections:

1. Section - Aggregate: Aggregate for backfill in trenches.
2. Section - Backfill: Execution requirements for backfilling required by this section.
3. Section - Trenching: Execution requirements for trenching required by this section.
4. Section - Firestopping: Product requirements for firestopping for placement by this section.
5. Section - Access Doors and Panels: Access doors for concealed valves and accessories.
6. Section - Paints and Coatings: Product requirements for painting for placement by this section.
7. Section 230529 - Supports and Anchors: Product requirements for pipe hangers and supports and sleeves, for placement by this section.
8. Section 230548 - Vibration Isolation: Product requirements for Vibration Isolation for placement by this section.

##### 1.2 REFERENCES

###### A. Air-Conditioning and Refrigeration Institute:

1. ARI 495 - Refrigerant Liquid Receivers.
2. ARI 710 - Liquid-Line Driers.
3. ARI 730 - Flow-Capacity Rating and Application of Suction-Line Filters and Filter Dryers.
4. ARI 750 - Thermostatic Refrigerant Expansion Valves.
5. ARI 760 - Solenoid Valves for Use with Volatile Refrigerants.

###### B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 15 - Safety Code for Mechanical Refrigeration.

2. ASHRAE 147 - Reducing the Release of Halogenated Refrigerants from Refrigerating and Air-Conditioning Equipment and Systems.
- C. American Society of Mechanical Engineers:
1. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
  2. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
  3. ASME B31.5 - Refrigeration Piping.
  4. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.
- D. American Society for Testing and Materials:
1. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
  2. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
  3. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
  4. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric).
  5. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
  6. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
  7. ASTM B749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products.
- E. American Welding Society:
1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
  2. AWS D1.1 - Structural Welding Code - Steel.
- F. Manufacturers Standardization Society of the Valve and Fittings Industry:
1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
  2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
  3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- G. Underwriters Laboratories Inc.:
1. UL 429 - Electrically Operated Valves.

### 1.3 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections when joining dissimilar metals in systems.
- B. Provide flanges, unions, or couplings at locations requiring servicing. Use unions, flanges, or couplings downstream of valves and at equipment connections. Do not use direct welded or threaded connections to valves or equipment.
- C. Provide pipe hangers and supports in accordance with ASME B31.5, ASTM F708, MSS SP 58, MSS SP 69, and MSS SP 89.
- D. Flexible Connectors: Use at or near compressors where piping configuration does not absorb vibration.

#### 1.4 SUBMITTALS

- A. Division 1 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate layout of refrigeration piping system, including equipment, critical dimensions, and sizes.
- C. Product Data:
  - 1. Piping: Submit data on pipe materials, fittings, and accessories.
  - 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
  - 3. Hangers and Supports: Submit manufacturers catalog information including load capacity.
  - 4. Refrigerant Specialties: Submit manufacturers catalog information including capacity, component sizes, rough-in requirements, and service sizes for the following:
    - a. Refrigerant strainers.
    - b. Refrigerant pressure regulators.
    - c. Refrigerant pressure relief valves.
    - d. Refrigerant filter-driers.
    - e. Refrigerant solenoid valves.
    - f. Refrigerant capillary tubes.
    - g. Electronic expansion valves.
- D. Design Data: Indicate pipe size. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- E. Test Reports: Indicate results of refrigerant leak test and piping system pressure test.
- F. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures and isolation.
- G. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- H. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Division 1 - Execution Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of valves, equipment and refrigerant accessories.
- C. Operation and Maintenance Data: Submit instructions for installation and changing components, spare parts lists, exploded assembly views.

#### 1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with ASME B31.5 code for installation of refrigerant piping systems.

- B. Perform Work in accordance with AWS D1.1 for welding hanger and support attachments to building structure.
- C. Perform Work in accordance with State of Florida standards.
- D. Maintain one copy of document on site.

#### 1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Fabricator or Installer: Company specializing in performing Work of this section with minimum three years documented experience.
- C. Design piping system and hangers and supports under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Florida.

#### 1.8 PRE-INSTALLATION MEETINGS

- A. Division 1 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Division 1 - Product Requirements: Product storage and handling requirements.
- B. Dehydrate and charge refrigeration components including piping and receivers, seal prior to shipment. Maintain seal until connected into system.
- C. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

#### 1.10 ENVIRONMENTAL REQUIREMENTS

- A. Division 1 - Product Requirements.

#### 1.11 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

## 1.12 COORDINATION

- A. Division 1 - Administrative Requirements: Requirements for coordination.

## 1.13 WARRANTY

- A. Division 1 - Execution Requirements: Product warranties and product bonds.
- B. Furnish five year manufacturer warranty for valves excluding packing.

## 1.14 MAINTENANCE MATERIALS

- A. Division 1 - Execution Requirements: Spare parts and maintenance products.
- B. Furnish two refrigerant oil test kits each containing everything required for conducting one test.

## 1.15 EXTRA MATERIALS

- A. Division 1 - Execution Requirements: Spare parts and maintenance products.
- B. Furnish two packing kits for each size and valve type.
- C. Furnish two refrigerant filter-dryer cartridges of each type.

## 2PART PRODUCTS

### 2.1 REFRIGERANT PIPING

- A. Copper Tubing: ASTM B280, Type ACR hard drawn or annealed.
  - 1. Fittings: ASME B16.22 wrought copper.
  - 2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F (640 to 805 degrees C).

### 2.2 UNIONS, FLANGES, AND COUPLINGS

- A. 2 inches (50 mm) and Smaller:
  - 1. Ferrous Piping: 150 psig (1034 kPa) malleable iron, threaded.
  - 2. Copper Pipe: Bronze, soldered joints.
- B. 2-1/2 inches (65 mm) and Larger:
  - 1. Ferrous Piping: 150 psig (1034 kPa) forged steel, slip-on.
  - 2. Copper Piping: Bronze.
  - 3. Gaskets: 1/16 inch (1.6 mm) thick preformed neoprene.
- C. Grooved and Shouldered Pipe End Couplings:
  - 1. Housing Clamps: Malleable iron galvanized to engage and lock designed to permit some angular deflection, contraction, and expansion.

2. Sealing Gasket: C-shape elastomer composition for operating temperature range from -30 degrees F (-34 degrees C) to 230 degrees F (110 degrees C).
  3. Accessories: Steel bolts, nuts, and washers.
- D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

### 2.3 PIPE HANGERS AND SUPPORTS

- A. See Section 230529 for pipe supports.

### 2.4 VALVES

- A. Diaphragm Packless Valves:
1. UL listed, globe or angle pattern, forged brass body and bonnet solder or flared ends.
  2. Phosphor bronze and stainless steel diaphragms, rising stem and hand wheel.
  3. Stainless steel spring, nylon seats, disc with positive back seating.
  4. Maximum working pressure: 500 psig (3450 kPa)
  5. Maximum working temperature: 275 degrees F (135 degrees C).
- B. Packed Angle Valves:
1. Forged brass or nickel-plated forged steel, solder or flared ends.
  2. Forged brass seal caps with copper gasket, rising stem and seat, molded stem packing.
  3. Maximum working pressure: 500 psig (3450 kPa)
  4. Maximum working temperature: 275 degrees F (135 degrees C).
- C. Ball Valves:
1. Two piece forged brass body with teflon ball seals and copper tube extensions, brass seal cap, chrome plated ball, stem with neoprene ring stem seals, soldered ends.
  2. Maximum working pressure: 500 psig (3450 kPa).
  3. Maximum working temperature: 300 degrees F (149 degrees C).
- D. Service Valves:
1. Forged brass body with copper stubs, brass caps, removable valve core, flared or solder ends.
  2. Maximum working pressure: 500 psig (3450 kPa).
- E. Refrigerant Check Valves:
1. Furnish materials in accordance with State of Florida standards.
  2. Globe Type:
    - a. Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless steel spring, teflon seat disc.
    - b. Maximum working pressure: 425 psig (2930 kPa).
    - c. Maximum working temperature: 300 degrees F (149 degrees C).
  3. Straight Through Type:
    - a. Spring, neoprene seat.
    - b. Maximum working pressure: 500 psig (3450 kPa).
    - c. Maximum working temperature: 250 degrees F (121 degrees C).



## 2.5 REFRIGERANT STRAINERS

- A. Straight Line or Angle Line Type:
  - 1. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass.
  - 2. Maximum working pressure: 430 psig (2960 kPa).
- B. Straight Line, Non-Cleanable Type:
  - 1. Steel shell, copper plated fittings, stainless steel wire screen.
  - 2. Maximum working pressure: 500 psig (3450 kPa).

## 2.6 REFRIGERANT PRESSURE REGULATORS

- A. Brass body, stainless steel diaphragm, adjustable over 0 to 80 psig (0 to 550 kPa) range, for maximum working pressure of 450 psig (3100 kPa).

## 2.7 REFRIGERANT PRESSURE RELIEF VALVES

- A. Straight Through or Angle Type: Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB; for standard 450 psig (3100 kPa) setting; selected to ASHRAE 15.

## 2.8 REFRIGERANT FILTER-DRIERS

- A. Replaceable Cartridge Angle Type:
  - 1. Shell: ARI 710, UL listed, brass, removable cap, for maximum working pressure of 500 psig (3450 kPa).
  - 2. Filter Cartridge: Pleated media with integral end rings, stainless steel support, ARI 730 rating for 20 tons (76,430 W)].
  - 3. Filter/Dryer Cartridge: Pleated media with solid core sieve with activated alumina, ARI 730 rating for 20 tons (76,430 W)].
  - 4. Wax Removal Cartridge: Molded bonded core of activated charcoal with integral gaskets.
- B. Permanent Straight Through Type:
  - 1. ARI 710, UL listed, steel shell with molded desiccant filter core, for maximum working pressure of 500 psig (3450 kPa).
  - 2. Rating: ARI 710 flow capacity of 20 tons (76,430 W) and ARI 730 flow capacity of 20 tons (76,430 W).

## 2.9 REFRIGERANT SOLENOID VALVES

- A. Valve: ARI 760, pilot operated, copper or brass body and internal parts, synthetic seat, stainless steel stem and plunger assembly, integral strainer, with flared, solder, or threaded ends; for maximum working pressure of 450 psig (3100 kPa). Stem designed to allow manual operation in case of coil failure.
- B. Coil Assembly: UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and color coded lead wires, integral junction box.
- C. Electrical Characteristics: See Division 26 for requirements.

## 2.10 REFRIGERANT EXPANSION VALVES

- A. Angle or Straight Through Type: ARI 750; design suitable for refrigerant, brass body, internal or external equalizer, adjustable superheat setting, replaceable inlet strainer, with replaceable capillary tube and remote sensing bulb and remote bulb well.
- B. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10 degrees F (6 degrees C) superheat. Select to avoid being undersized at full load and oversized at part load.

## 2.11 ELECTRONIC EXPANSION VALVES

- A. Valve:
  - 1. Brass bodies with flared or solder connection, needle valve with floating needle and machined seat, stepper motor drive.
  - 2. Capacity: Nominal 20 tons (76,430 W).
  - 3. Electrical Characteristics: See Division 26 for requirements.
- B. Evaporation Control System:
  - 1. Electronic microprocessor based unit in enclosed case, proportional integral control with adaptive superheat, maximum operating pressure function, pre-selection allowance for electrical defrost and hot gas bypass.
  - 2. Electrical Characteristics: See Division 26 for requirements.
- C. Refrigeration System Control: Electronic microprocessor based unit in enclosed case, with proportional integral control of valve, on/off thermostat, air temperature alarm (high and low), solenoid valve control, liquid injection adaptive superheat control, maximum operating pressure function, night setback thermostat, timer for defrost control.

## 2.12 REFRIGERANT RECEIVERS

- A. Internal Diameter 6 inch (150 mm) and Smaller: ARI 495, UL listed, steel, brazed; 400 psig (2760 kPa) maximum pressure rating, with taps for inlet, outlet, and pressure relief valve.
- B. Internal Diameter 6 inch (150 mm) and Larger: ARI 495, welded steel, tested and stamped in accordance with ASME Section VIII; 400 psig (2760 kPa) with taps for liquid inlet and outlet valves, pressure relief valve.

## 3 PART EXECUTION

### 3.1 EXAMINATION

- A. Division 1 - Administrative Requirements: Coordination and project conditions.

### 3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.

- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

### 3.3 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install hangers and supports in accordance with ASME B31.5, ASTM F708, and MSS SP 89.
- B. Support horizontal piping hangers as scheduled.
- C. Install hangers to provide minimum 1/2 inch (13 mm) space between finished covering and adjacent work.
- D. Place hangers within 12 inches (300 mm) of each horizontal elbow.
- E. Install hangers to allow 1-1/2 inch (38 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
- F. Support vertical piping under roof. Support riser piping independently of connected horizontal piping.
- G. Where installing several pipes in parallel and at same elevation, provide multiple pipe hangers or trapeze hangers.
- H. Provide sheet lead packing between hanger or support and piping.
- I. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

### 3.4 INSTALLATION - PIPING SYSTEMS

- A. Install piping to conserve building space, and not interfere with use of space.
- B. Group piping whenever practical at common elevations.
- C. Sleeve pipe passing through partitions, walls and floors.
- D. Install pipe identification in accordance with Section 230503.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Provide access where valves and fittings are not exposed.
- G. Arrange refrigerant piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.
- H. Flood refrigerant piping system with nitrogen when brazing.
- I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

- J. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting.
- K. Install valves with stems upright or horizontal, not inverted.
- L. Insulate suction and liquid refrigerant piping with 2 inch elastomeric pipe insulation.
- M. Provide replaceable cartridge filter-dryers, with isolation valves and bypass with valve.
- N. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.
- O. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.
- P. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.
- Q. Provide electrical connection to solenoid valves. Refer to Division 26 for requirements.
- R. Fully charge completed system with refrigerant after testing.
- S. Follow ASHRAE 15 and 147 procedures for charging and purging of systems and for disposal of refrigerant.
- T. Install refrigerant piping in accordance with ASME B31.5.

### 3.5 INSTALLATION - REFRIGERANT SPECIALTIES

- A. Refrigerant Liquid Indicators:
  1. When receiver is provided, install line size liquid indicators in liquid line downstream of receiver.
  2. Install line size liquid indicators downstream of liquid solenoid valves.
- B. Refrigerant Valves:
  1. Install service valves on compressor suction and discharge.
  2. Install gage taps at compressor inlet and outlet.
  3. Install gage taps at hot gas bypass regulators, inlet and outlet.
  4. Install check valves on compressor discharge.
  5. Install check valves on condenser liquid lines on multiple condenser systems.
  6. Install refrigerant charging valve in liquid line between receiver shut-off valve and expansion valve.
- C. Strainers:
  1. Install line size strainer upstream of each automatic valve.
  2. Where multiple expansion valves with integral strainers are used, install single main liquid-line strainer.
  3. On steel piping systems, install strainer in suction line.
  4. Install shut-off valves on each side of strainer.
- D. Install pressure relief valves on ASME receivers. Install relief valve discharge piping to terminate outdoors.

- E. Filter-Dryers:
  - 1. Install permanent filter-dryers in low temperature systems.
  - 2. Install permanent filter-dryer in systems containing hermetic compressors.
  - 3. Install replaceable cartridge filter-dryer vertically in liquid line adjacent to receivers.
  - 4. Install replaceable cartridge filter-dryer upstream of each solenoid valve.
  
- F. Solenoid Valves:
  - 1. Install in liquid line of systems operating with single pump-out or pump-down compressor control.
  - 2. Install in liquid line of single or multiple evaporator systems.
  - 3. Install in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into suction line when system shuts down.

### 3.6 FIELD QUALITY CONTROL

- A. Division 1 - Quality Requirements: Testing and Inspection Services.
- B. Test refrigeration system in accordance with ASME B31.5.
- C. Repair leaks.
- D. Retest until no leaks are detected.

END OF SECTION



## SECTION 23 25 00

### CHEMICAL WATER TREATMENT

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Cleaning of piping systems.
- B. Chemical feeder equipment.
- C. Chemical treatment.

##### 1.2 SUBMITTALS

- A. Submit Shop Drawings: Indicate system schematic, equipment locations, and controls schematics, electrical characteristics and connection requirements.
- B. Product Data: Provide chemical treatment materials, chemicals, and equipment.
- C. Manufacturer's Installation Instructions: Indicate placement of equipment in systems, piping configuration, and connection requirements.
- D. Manufacturer's Field Reports: Indicate start-up of treatment systems when completed and operating properly. Indicate analysis of system water after cleaning and after treatment.
- E. Submit certificate of compliance from authority having jurisdiction indicating approval of chemicals and their proposed disposal.

##### 1.3 PROJECT RECORD DOCUMENTS

- A. Record actual locations of equipment and piping, including sampling points and location of chemical injectors.

##### 1.4 REGULATORY REQUIREMENTS

- A. Conform to applicable code for addition of non-potable chemicals to building mechanical systems, and for to public sewage systems.

#### 2 PART PRODUCTS

##### 2.1 MATERIALS

- A. Closed System Treatment (Chilled and Hot Water):
  - 1. Sequestering agent to reduce deposits and adjust pH; polyphosphate.
  - 2. Corrosion inhibitors; liquid boron-nitrite, sodium nitrite and borax, sodium totyltriazole, low molecular weight polymers, phosphonates, sodium molybdate, or sulphites.
  - 3. Conductivity enhancers; phosphates or phosphonates.

## 2.2 COMBINATION FILTER/FEEDER

- A. Specifications:
  - 1. See Mechanical Drawings.

## 3PART EXECUTION

### 3.1 PREPARATION

- A. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.
- B. Place terminal control valves in open position during cleaning.

### 3.2 CLEANING SEQUENCE

- A. Concentration:
  - 1. As recommended by manufacturer.
  - 2. One pound per 100 gallons of water contained in the system.
  - 3. One pound per 100 gallons of water for hot systems and one pound per 50 gallons of water for cold systems.
- B. Hot Water Heating Systems:
  - 1. Apply heat while circulating, slowly raising temperature to 160 degrees F and maintain for 12 hours minimum.
  - 2. Remove heat and circulate to 100 degrees F or less; drain systems as quickly as possible and refill with clean water.
  - 3. Circulate for 6 hours at design temperatures, then drain.
  - 4. Refill with clean water and repeat until system cleaner is removed.
- C. Chilled Water Systems:
  - 1. Circulate for 48 hours, then drain systems as quickly as possible.
  - 2. Refill with clean water, circulate for 24 hours, then drain.
  - 3. Refill with clean water and repeat until system cleaner is removed.
- D. Use neutralizer agents on recommendation of system cleaner supplier.
- E. Remove, clean, and replace strainer screens and socks.
- F. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

### 3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.



### 3.4 CLOSED SYSTEM TREATMENT

- A. Provide one combination filter/feeder on each system. Install isolating and drain valves and necessary piping. Install around balancing valve downstream of circulating pumps unless indicated otherwise.
- B. Introduce closed system treatment through combination filter/feeder when required or indicated by test.
- C. Provide 2" inlet and drain to connect to fire hydrant for flushing.
- D. Flush all branches and main circuits pumped with house pumps at velocities above 7FPS until water is clear. Engineer's approval required.

END OF SECTION



## SECTION 233100

### DUCTS

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
1. Duct Materials.
  2. Insulated flexible ducts.
  3. Single wall spiral round ducts.
  4. Ductwork fabrication.
  5. Kitchen hood exhaust ductwork fabrication.
  6. Duct cleaning.
- B. Related Sections:
1. Division 3 - Cast-In-Place Concrete: Product requirements for concrete for placement by this section.
  2. Division 9 - Paints and Coatings: Execution requirements for Weld priming, weather resistant, paint or coating specified by this section.
  3. Division 11 - Food Service Equipment: Product requirements for kitchen range hoods for placement by this section.
  4. Section 230529 - Supports and Anchors: Product requirements for hangers, supports and sleeves for placement by this section.
  5. Section 233300 - Ductwork Accessories: Product requirements for duct accessories for placement by this section.

##### 1.2 REFERENCES

- A. ASTM International:
1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
  2. ASTM A90/A90M - Standard Test Method for Weight Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
  3. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
  4. ASTM A568/A568M - Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.
  5. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  6. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
  7. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
  8. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
  9. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

10. ASTM C14 - Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
  11. ASTM C14M - Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe (Metric).
  12. ASTM C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
  13. ASTM C443M - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets (Metric).
  14. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. National Fire Protection Association:
1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
  2. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
  3. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- C. Sheet Metal and Air Conditioning Contractors:
1. SMACNA - Fibrous Glass Duct Construction Standards.
  2. SMACNA - HVAC Air Duct Leakage Test Manual.
  3. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.
- D. Underwriters Laboratories Inc.:
1. UL 181 - Factory-Made Air Ducts and Connectors.

### 1.3 PERFORMANCE REQUIREMENTS

- A. Variation of duct configuration or sizes other than those of equivalent or lower loss coefficient is not permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

### 1.4 SUBMITTALS

- A. Division 1 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Submit duct fabrication drawings, drawn to scale not smaller than 1/8 inch equals 1 foot, on drawing sheets same size as Contract Documents, indicating:
1. Fabrication, assembly, and installation details, including plans, elevations, sections, details of components, and attachments to other work.
  2. Duct layout, indicating pressure classifications and sizes in plan view. For exhaust duct systems, indicate classification of materials handled as defined in this section.
  3. Fittings.
  4. Reinforcing details and spacing.
  5. Seam and joint construction details.
  6. Penetrations through fire rated and other walls.
  7. Terminal unit, coil, and humidifier installations.
  8. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.

- C. Product Data: Submit data for duct materials, duct liner, and duct connectors.
- D. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Division 1 - Execution Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

#### 1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and flexible.
- B. Construct ductwork to NFPA 90A, NFPA 90B, and NFPA 96 standards.
- C. Maintain one copy of each document on site.

#### 1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years experience.

#### 1.8 PRE-INSTALLATION MEETINGS

- A. Division 1 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

#### 1.9 ENVIRONMENTAL REQUIREMENTS

- A. Division 1 - Product Requirements.
- B. Do not install duct sealant when temperatures are less than those recommended by sealant manufacturers.
- C. Maintain temperatures during and after installation of duct sealant.

#### 1.10 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

## 2PART PRODUCTS

### 2.1 DUCT MATERIALS

- A. Galvanized Steel Ducts: ASTM A653/A653M galvanized steel sheet, lock-forming quality, having G90 zinc coating of in conformance with ASTM A90/A90M.
- B. Steel Ducts: ASTM A1008/A1008M.
- C. Aluminum Ducts: ASTM B209 (ASTM B209M); aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T6 or of equivalent strength.
- D. Stainless Steel Ducts: ASTM A167, Type 304.
- E. Fasteners: Rivets, bolts, or sheet metal screws.
- F. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

### 2.2 INSULATED FLEXIBLE DUCTS

- A. UL 181, Class 1, constructed with interior liner of round corrugated steel or aluminum duct with exterior fiberglass insulation and vinyl film vapor barrier.
  - 1. Pressure Rating: 10 inches wg (2.5 kPa) positive or negative.
  - 2. Maximum Velocity: 4000 fpm (20.3 m/s).
  - 3. Temperature Range: -20 degrees F to 210 degrees F (-28 degrees C to 99 degrees C).
  - 4. Thermal Resistance: 4.2 square feet-hour-degree F per BTU.
  - 5. Furnish each flexible duct section with integral clamping devices for connection to round or oval fittings and screws.
  - 6. Join each flexible duct section to main trunk duct through sheet metal fittings. Construct fittings of galvanized steel and equip with factory installed volume damper having positive locking regulator. Provide fittings installed in lined ductwork with insulation guard.
  - 7. Maximum field measured pressure drop shall not exceed 0.1 inches in 5'-0" at design air flow. If it does, increase size until pressure drop is within specification.
  - 8. Flexible ductwork shall be a minimum of 2 inches larger than equipment inlet or that shown on Contract Documents, whichever is larger. Provide reducers to fit equipment or neck sizes of air flow devices.

### 2.3 SINGLE WALL SPIRAL ROUND DUCTS

- A. Product Description: UL 181, Class 1, round spiral lockseam duct constructed of galvanized steel.

- B. Construct duct with the following minimum gages:

	Diameter	Gauge
1.	3 inches to 14 inches	26
2.	15 inches to 26 inches	24
3.	28 inches to 36 inches	22
4.	38 inches to 50 inches	20
5.	52 inches to 84 inches	18

- C. Construct fittings with the following minimum gages:
- |    | Diameter               | Gauge |
|----|------------------------|-------|
| 1. | 3 inches to 14 inches  | 24    |
| 2. | 15 inches to 26 inches | 22    |
| 3. | 28 inches to 36 inches | 20    |
| 4. | 38 inches to 50 inches | 20    |
| 5. | 52 inches to 60 inches | 18    |
| 6. | 62 inches to 84 inches | 16    |

## 2.4 DUCTWORK FABRICATION

- A. Fabricate and support rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible and as indicated on Drawings. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Fabricate and support round ducts with spiral seams in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible (Round Duct Construction Standards). Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- C. Construct T's, bends, and elbows with minimum radius 1-1/2 times centerline duct width. Where not possible and where rectangular elbows are used, provide turning vanes. Where acoustical lining is indicated, furnish turning vanes of perforated metal with glass fiber insulation.
- D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- E. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Minimum 4 inch (100 mm) cemented slip joint, brazed or electric welded. Prime coat welded joints.
- F. Provide standard 45-degree lateral wye takeoffs. When space does not allow 45-degree lateral wye takeoff, use 90-degree conical tee connections.

## 2.5 KITCHEN HOOD EXHAUST DUCTWORK FABRICATION

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible and NFPA 96.
- B. Exposed Kitchen Hood Exhaust Ducts and Skirts: Construct of stainless steel ASTM A167, type 316 using continuous external welded joints. Must pass light test.
- C. Concealed Kitchen Hood Exhaust Ducts: Construct of 18 gage (1.09 mm) stainless steel ASTM A167, type 304 using continuous external welded joints. Must pass light test.
- D. Supply ductwork to hood, per SMACNA, G90 galvanized.

### 3 PART EXECUTION

#### 3.1 EXAMINATION

- A. Division 1 - Administrative Requirements: Coordination and project conditions.
- B. Verify sizes of equipment connections before fabricating transitions.

#### 3.2 INSTALLATION

- A. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- B. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible. Use high pressure duct sealant on all joints and seams, inside and outer cover.
- C. Install glass fiber ducts in accordance with SMACNA Fibrous Glass Duct Construction Standards. Obtain manufacturer's inspection and acceptance of fabrication and installation at beginning of installation.
- D. During construction, install temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- E. Use crimp joints with or without bead or beaded sleeve couplings for joining round duct sizes 10 inch and smaller.
- F. Install duct hangers and supports in accordance with SMACNA and such as not to have sags in runs.
- G. Use double nuts and lock washers on threaded rod supports.
- H. Connect flexible ducts to metal ducts with adhesive draw bands, adhesive plus sheet metal screws. Provide a minimum of two screws opposite of each other on round duct extractors. Install extractor spin ins with four screws, one on each corner.
- I. Connect flexible ducts to metal ducts with draw bands and adhesive plus sheet metal screws.
- J. Set plenum doors 6 to 12 inches (150 to 300 mm) above floor. Arrange door swing so fan static pressure holds door in closed position.
- K. Install kitchen range hoods in accordance with NFPA 96.
- L. Install residue traps in kitchen hood exhaust ducts at base of vertical risers with provisions for clean out.
- M. Kitchen hood exhaust ducts: Use stainless steel for ductwork exposed to view and stainless steel where ducts are concealed.



### 3.3 INTERFACE WITH OTHER PRODUCTS

- A. Install openings in ductwork where required to accommodate thermometers and controllers. Install pitot tube openings for testing of systems. Install pitot tube complete with metal can with spring device or screw to prevent air leakage. Where openings are provided in insulated ductwork, install insulation material inside metal ring.
- B. Connect diffusers boots to low pressure ducts directly above hard ceiling with 5 feet (1.5 m) maximum length of flexible duct held in place with strap or clamp above lay-in ceilings.
- C. Connect air terminal units and air outlets and inlets to supply ducts directly or with five foot (1.5 m) maximum length of flexible duct. Do not use flexible duct to change direction above hard ceilings. Direct connections required.

### 3.4 CLEANING

- A. Division 1 - Execution Requirements: Final cleaning.
- B. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air flow, clean one half of system completely before proceeding to other half. Protect equipment with potential to be harmed by excessive dirt with temporary filters, or bypass during cleaning.
- C. Clean duct systems with high power vacuum machines. Protect equipment with potential to be harmed by excessive dirt with filters, or bypass during cleaning. Install access openings into ductwork for cleaning purposes.
- D. Provide caps on open ductwork to keep debris/dirt from entering hung ductwork.

### 3.5 SCHEDULES

#### DUCTWORK MATERIAL SCHEDULE

AIR SYSTEM	MATERIAL
Supply (Heating Systems)	Galvanized Steel, Aluminum
Supply (System with Cooling Coils)	Galvanized Steel, Aluminum
Return and Relief	Galvanized Steel, Aluminum
General Exhaust	Galvanized Steel, Aluminum
Kitchen Hood Exhaust	Stainless Steel
Dishwasher Exhaust	Stainless Steel
Hood and Outside Air Intake	Galvanized Steel

### DUCTWORK PRESSURE CLASS SCHEDULE

AIR SYSTEM	PRESSURE CLASS
Constant Volume Supply	2 inch wg regardless of velocity.
Variable Volume-Variable Temperature Supply	3 inch wg regardless of velocity.
Variable Air Volume Supply (downstream of VAV boxes)	1 inch wg regardless of velocity.
Variable Air Volume Supply (upstream of VAV boxes)	3 inch wg
Supply (Heating Systems)	3 inch wg (250 Pa)
Supply (System with Cooling Coils)	3 inch wg (500 Pa)
Return and Relief	1 inch wg (250 Pa) regardless of velocity.
General Exhaust	1 inch wg (250 Pa) regardless of velocity.
Dishwasher Exhaust	2 inch wg (500 Pa)
Fume Hood Exhaust	2 inch wg (500 Pa)
Emergency Generation Ventilation	1 inch wg (125 Pa)

END OF SECTION

SECTION 23 33 00  
DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Air turning devices/extractors.
- B. Backdraft dampers.
- C. Combination fire and smoke dampers.
- D. Duct access doors.
- E. Duct test holes.
- F. Fire dampers/Smoke dampers
- G. Flexible duct connections.
- H. Volume control dampers.

1.2 RELATED SECTIONS

- A. Section 233100 - Ducts
- B. Section 233600 - Air Terminal Units: Pressure regulating damper assemblies.
- C. Division 26 - Equipment Wiring Systems: Electrical characteristics and wiring connections.

1.3 REFERENCES

- A. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- B. NFPA 92A - Smoke Control Systems.
- C. NFPA 70 - National Electrical Code.
- D. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- E. UL 33 - Heat Responsive Links for Fire-Protection Service.
- F. UL 555 - Fire Dampers and Ceiling Dampers.
- G. UL 555S - Leakage Rated Dampers for Use in Smoke Control Systems.

#### 1.4 SUBMITTALS

- A. Submit Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers, duct access doors and duct test holes.
- B. Product Data: Provide for shop fabricated assemblies including volume control dampers, duct access doors, duct test holes and hardware used. Include electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions: Indicate for fire dampers and combination fire and smoke dampers.

#### 1.5 PROJECT RECORD DOCUMENTS

- A. Submit and record actual locations of access doors, test holes and volume dampers.

#### 1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

#### 1.7 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories Inc., as suitable for the purpose specified and indicated.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site.
- B. Protect dampers from damage to operating linkages and blades.

### 2PART PRODUCTS

#### 2.1 AIR TURNING DEVICES/EXTRACTORS

- A. Multi-blade device with radius blades attached to pivoting frame and bracket, steel or aluminum construction, with worm drive mechanism with 18 inch long removable key operator.

#### 2.2 BACKDRAFT DAMPERS

- A. Gravity Backdraft Dampers, Size 24 x 24 inches or Smaller, Furnished with All Air Moving Equipment: Air moving equipment manufacturers standard construction. Aluminum with corrosion resistant polymer bushings or bearings.
- B. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: 16 gage thick extruded aluminum, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, ball bearings, and plated pivot pin; adjustment device to permit setting for varying differential static pressure.

## 2.3 COMBINATION FIRE AND SMOKE DAMPERS

- A. Provide where required by Code having jurisdiction.
- B. Fabricate in accordance with NFPA 90A, UL 555, UL 555S, and as indicated.
- C. Provide factory sleeve and collar for each damper.
- D. Multiple Blade Dampers: Fabricate with 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, 1/8 x 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock, and 1/2 inch actuator shaft.
- E. Operators: UL listed and labeled spring return electric type suitable for 120 volts, single phase, 60 Hz. Locate damper operator on exterior of duct and link to damper operating shaft.
- F. Normally Closed Smoke Responsive Fire Dampers: Curtain type, opening by gravity upon actuation of electro thermal link, flexible stainless steel blade edge seals to provide constant sealing pressure. Provide as required to meet Florida Mechanical and Building Codes.
- G. Normally Open Smoke Responsive Fire Dampers: Curtain type, closing upon actuation of electro thermal link, flexible stainless steel blade edge seals to provide constant sealing pressure, stainless steel springs with locking devices to ensure positive closure for units mounted horizontally. Provide as required to meet Florida Mechanical and Building Codes.
- H. Electro Thermal Link: Fusible link melting at 165 degrees F; 120 volts, single phase, 60 Hz; UL listed and labeled.

## 2.4 DUCT ACCESS DOORS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- B. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum two inch thick insulation with sheet metal cover.
  - 1. Less Than 12 Inches Square: Secure with sash locks.
  - 2. Up to 18 Inches Square: Provide two hinges and two sash locks.
- C. Access doors with sheet metal screw fasteners are not acceptable.

## 2.5 DUCT TEST HOLES

- A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, threaded plugs, or threaded or twist-on metal caps.
- B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

## 2.6 FIRE DAMPERS

- A. Provide where required by Codes having jurisdiction in all fire walls as indicated on Architectural Plans.
- B. Fabricate in accordance with NFPA 90A and UL 555, and as indicated on both Mechanical and Architectural Plans.
- C. Horizontal Dampers: Code approved, Galvanized steel, 22 gage frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket.
- D. Curtain Type Dampers: Code approved, Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations closure under air flow conditions. Configure with blades out of air stream.
- E. Code approved Multiple Blade Dampers: 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 x 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.
- F. Fusible Links: UL 33, separate at 160 degrees F with adjustable link straps for combination fire/balancing dampers.

## 2.7 FLEXIBLE DUCT CONNECTIONS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- B. Connector: Fabric crimped into metal edging strip.
  - 1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.
  - 2. Net Fabric Width: Approximately 3 inches wide.

## 2.8 SMOKE DAMPERS

- A. Provide where required by Code having jurisdiction.
- B. Fabricate in accordance with NFPA 90A and UL 5555, and as indicated.
- C. Dampers: UL Class 1 multiple blade type fire damper, normally open automatically operated by electric actuator.
- D. Electro Thermal Link: Fusible link melting at 165 degrees F; 120 volts, single phase, 60 Hz; UL listed and labeled.

## 2.9 VOLUME CONTROL DAMPERS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

- B. Splitter Dampers:
  1. Material: Same gage as duct to 24 inches size in either direction, and two gages heavier for sizes over 24 inches.
  2. Blade: Fabricate of double thickness sheet metal to streamline shape, secured with continuous hinge or rod.
  3. Operator: Minimum 1/4 inch diameter rod in self aligning, universal joint action, flanged bushing with set screw.
- C. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
- D. End Bearings: Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.
- E. Quadrants:
  1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
  2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
  3. Where rod lengths exceed 30 inches provide regulator at both ends.

### 3PART EXECUTION

#### 3.1 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

#### 3.2 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 15890 for duct construction and pressure class.
- B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated.
- D. Provide duct test holes where indicated and required for testing and balancing purposes.
- E. Provide fire dampers, combination fire and smoke dampers and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction whether indicated on Plans or not. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- F. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92A.

- G. Demonstrate re-setting of fire dampers to Owner's representative.
- H. Provide 6 inch flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment, and supported by vibration isolators.
- I. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.
- J. Use splitter dampers only where indicated.
- K. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION



SECTION 23 34 00  
POWER VENTILATORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Sidewall centrifugal exhaust fans.
- B. Centrifugal square inline fans.
- C. Combination kitchen hood exhaust fans.

1.2 RELATED SECTIONS

- A. Section 233100 - Ductwork.
- B. Section 233300 - Duct Accessories: Backdraft dampers.
- C. Division 26 - Equipment Wiring Systems: Electrical characteristics and wiring connections.

1.3 REFERENCES

- A. AMCA 99 - Standards Handbook.
- B. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.
- C. AMCA 261 - Directory of Products Licensed to Bear the AMCA Certified Ratings Seal.
- D. AMCA 300 - Test Code for Sound Rating Air Moving Devices.
- E. AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.
- F. NEMA MG1 - Motors and Generators.
- G. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease Vapors from Commercial cooking Equipment.
- H. UL 705 - Power Ventilators.

1.4 SUBMITTALS FOR REVIEW

- A. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements.

1.5 SUBMITTALS FOR INFORMATION

- A. Manufacturer's Instructions: Indicate installation instructions.

## 1.6 SUBMITTALS AT PROJECT CLOSEOUT

- A. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.
- B. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer. All fans shall require 5 year warranty.

## 1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years experience.

## 1.8 REGULATORY REQUIREMENTS

- A. Kitchen Range Hood Exhaust Fans: Comply with requirements of NFPA 96.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

## 1.9 EXTRA MATERIALS

- A. Supply two sets of belts for each fan.

## 1.10 PRE-INSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing work of this section.

## 1.11 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors, shafts, and bearings from weather and construction dust.

## 1.12 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

## 1.13 MAINTENANCE SERVICE

- A. Furnish service and maintenance of fans for one year from Date of Substantial Completion.
- B. Examine each fan's components monthly. Clean, adjust, and lubricate equipment.
- C. Include systematic examination, adjustment, and lubrication of fans, and controls checkout and adjustments. Repair or replace parts in accordance with manufacturer's operating and maintenance data. Use parts produced by manufacturer of original equipment.
- D. Perform work without removing fans from service during building normal occupied hours.
- E. Provide emergency call back service during working hours for this maintenance period.

- F. Maintain locally, near Place of the Work, adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.
- G. Perform maintenance work using competent and qualified personnel under supervision of manufacturer or original installer.
- H. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of Owner.

## PART 2 - PRODUCTS

### 2.1 SIDEWALL CENTRIFUGAL EXHAUST FANS

- A. Manufacturers:
  - 1. Greenheck Corp., Loren Cook Company, Penn Ventilation, or equal.
- B. Fan Unit: Sidewall type. V-belt drive, spun aluminum housing with grease tray; resilient mounted motor; aluminum wire bird screen; square base to suit wall mount.
- C. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.
- D. Motor: In accordance with Division 26.
- E. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor NEMA 1 enclosure.
- F. Accessories:
  - 1. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked, damper tray.
- G. Performance: See Drawing Schedules.
- H. Electrical Characteristics and Components: In accordance with Division 26.
- J. Missile Impact: Comply with ASTM E1886, E1996 or Miami-Dade TAS 201, 202 or 203.

### 2.2 CENTRIFUGAL SQUARE INLINE FANS DUCTED

- A. Manufacturers:
  - 1. Greenheck Corp., Loren Cook Company, Penn Ventilation, or equal.
- B. Product Description: V-belt drive with galvanized steel housing lined with 1/2 inch (13 mm) acoustic glass fiber insulation, integral inlet cone, removable access doors on 3 sides, inlet and outlet duct collar, backdraft damper.
- C. Fan Wheel: Backward inclined centrifugal type, aluminum construction.

- D. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.
- E. Motor and Drive Mounting: Out of air stream.
- F. Motor: In accordance with Division 26.
- G. Bearings: ABMA 9 life at 200,000 hours.
- H. Accessories:
  - 1. Belt guard.
  - 2. Motor cover.
  - 3. Flexible duct connector (discharge side only).
  - 4. Inlet and outlet ductwork companion flange.
  - 5. Disconnect Switch: NEMA 1.
- I. Performance: See Drawing Schedule.
- J. Electrical Characteristics and Components: In accordance with Division 26.

### 2.3 KITCHEN HOOD EXHAUST FANS

- A. Manufacturers:
  - 1. Greenheck Corp., Loren Cook Company, Penn Ventilation, or equal.
- B. Exhaust Fan:
  - 1. Fan Unit: Belt driven, single width, single inlet centrifugal blower, galvanized steel housing with galvanized finish; resilient mounted motor; square base to suit roof curb.
  - 2. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.
  - 3. Motor: In accordance with Division 26.
- C. Roof Curb: Sized to accommodate fan. 12 inch (300 mm) high self-flashing of galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2 inch (40 mm), 3 pound per cubic foot (48 kg/cubic meter) density glass fiber insulation and curb bottom, and factory installed nailer strip.
- D. Gas Unit Heater: See scheduled equipment for details.
- E. Performance: See Drawing Schedule.
- F. Electrical Characteristics and Components: In accordance with Division 26.
- G. Missile Impact: Comply with ASTM E1886, E1996 or Miami-Dade TAS 201, 202 or 203.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify roof curbs are installed and dimensions are as instructed by manufacturer.

### 3.2 INSTALLATION

- A. Secure roof and wall fans with stainless steel lag screws to roof curb or wall structure.
- B. Install backdraft dampers and gravity shutters on roof and wall exhaust fans and gravity ventilators used in relief air applications, as shown on Drawings.
- C. Provide backdraft dampers on outlet from square in-line fans and ceiling fans and as indicated on Drawings.
- D. Hung Cabinet Fans:
  - 1. Install fans with resilient mountings and flexible electrical leads.
  - 2. Install flexible connections specified in Section 15910 between fan and ductwork. Ensure metal bands of connectors are parallel with minimum one inch (25 mm) flex between ductwork and fan while running.
- E. Install safety screen where inlet or outlet is exposed.
- F. Install flex connections on inlet and outlet of all square in-line exhaust fans, and where indicated on Drawings. Provide rubber isolators.
- G. Provide adjustable pitch sheaves required for final air balance.

### 3.3 MANUFACTURER'S FIELD SERVICES

- A. Furnish services of factory trained representative for start-up, calibrate controls, and instruct Owner on operation and maintenance.

### 3.4 CLEANING

- A. Vacuum clean inside of fan cabinet.

### 3.5 DEMONSTRATION

- A. Demonstrate fan operation and maintenance procedures.

### 3.6 PROTECTION OF FINISHED WORK

- A. Do not operate fans for until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.
- B. Provide sheaves required for final air balance.

- C. Install backdraft dampers on inlet to roof and wall exhausters.
- D. Provide backdraft dampers on outlet from cabinet and ceiling exhauster fans and as indicated.
- E. Do not operate fans until ductwork is clean, filters are in place, and bearings are lubricated.

END OF SECTION

## SECTION 23 37 00

### AIR OUTLETS AND INLETS

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Diffusers.
  - 2. Registers
  - 3. Grilles.
  - 4. Door grilles.
  - 5. Louvers.
  - 6. Roof hoods.
  
- B. Related Sections:
  - 1. Section 099000 - Paints and Coatings: Execution and product requirements for Painting of ductwork visible behind outlets and inlets specified by this section.
  - 2. Section 089100 - Wall Louvers: Wall Louvers.
  - 3. Section 233300 - Duct Accessories: Volume dampers for inlets and outlets.

##### 1.2 REFERENCES

- A. Air Movement and Control Association International, Inc.:
  - 1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.
  
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
  - 1. ASHRAE 70 - Method of Testing for Rating the Performance of Air Outlets and Inlets.
  
- C. Sheet Metal and Air Conditioning Contractors:
  - 1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

##### 1.3 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal procedures.
  
- B. Product Data: Submit sizes, finish, and type of mounting. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.
  
- C. Samples: Submit two of each required air outlet and inlet type.
  
- D. Test Reports: Rating of air outlet and inlet performance.
  
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

##### 1.4 CLOSEOUT SUBMITTALS

- A. Section 017000 - Execution Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of air outlets and inlets.

#### 1.5 QUALITY ASSURANCE

A. Test and rate diffuser, register, and grille performance in accordance with ASHRAE 70.

B. Test and rate louver performance in accordance with AMCA 500.

#### 1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

#### 1.7 PRE-INSTALLATION MEETINGS

A. Section 013000 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

#### 1.8 WARRANTY

A. Section 01700 - Execution Requirements: Product warranties and product bonds.

B. Furnish five year manufacturer warranty for air outlets and inlets.

#### 1.9 EXTRA MATERIALS

A. Section 017000 - Execution Requirements: Spare parts and maintenance products.

B. Furnish 5 percent extra air outlets and inlets; a minimum of one.

### 2 PART 2 - PRODUCTS

#### 2.1 RECTANGULAR CEILING DIFFUSERS

A. Manufacturers:

1. Price.
2. Titus.
3. Tuttle and Bailey.
4. Substitutions: Permitted.

B. Type: Square and rectangular, adjustable pattern, multi-louvered diffuser to discharge air in one way or four-way pattern with sector baffles as indicated on Drawings.

C. Frame: Surface mount type. In plaster ceilings, furnish plaster frame and ceiling frame.

D. Fabrication: Aluminum with baked enamel off-white finish.

E. Accessories: Radial opposed-blade damper and multi-louvered equalizing grid with damper adjustable from diffuser face. Provide round neck reducers as noted on plans.



## 2.2 CEILING SUPPLY REGISTERS/GRILLES

- A. Manufacturers:
  - 1. Price.
  - 2. Titus.
  - 3. Tuttle and Bailey.
  - 4. Substitutions: Permitted.
- B. Type: Streamlined and individually adjustable curved blades to discharge air along face of grille, one-way or two-way deflection.
- C. Frame: 1-1/4 inch margin with concealed mounting and gasket.
- D. Fabrication: Aluminum extrusions with factory off-white enamel finish.
- E. Damper: Integral, gang-operated, opposed-blade type with removable key operator, operable from face.

## 2.3 CEILING GRID AND WALL CORE EXHAUST AND RETURN REGISTERS/GRILLES

- A. Manufacturers:
  - 1. Price
  - 2. Titus.
  - 3. Tuttle and Bailey.
  - 4. Substitutions: Permitted.
- B. Type: Fixed grilles of 1/2 x 1/2 x 1 inch louvers.
- C. Fabrication: Aluminum with factory off-white baked enamel.
- D. Frame: 1 inch margin with concealed mounting. Channel lay-in frame for suspended grid ceilings.
- E. Damper: Integral, gang-operated, opposed-blade type with removable key operator, operable from face. No dampers required where indicated on plans. If required, provide as indicated above.

## 2.4 WALL SUPPLY REGISTERS/GRILLES

- A. Manufacturers:
  - 1. Price
  - 2. Titus.
  - 3. Tuttle and Bailey.
  - 4. Substitutions: Permitted.
- B. Type: Streamlined and individually adjustable blades, 3/4 inch (19 mm) minimum depth, maximum spacing with spring or other device to set blades, vertical face, double deflection. Where noted, provide drum louver with vertical and horizontal direction blades.
- C. Frame: 1-1/4 inch margin with concealed mounting and gasket.
- D. Fabrication: Aluminum extrusions, with factory off-white baked enamel finish.

- E. Damper: Integral, gang-operated opposed blade type with removable key operator, operable from face.
- F. Drum louver to be Titus DL SV type or equal.

## 2.5 WALL EXHAUST AND RETURN REGISTERS/GRILLES

- A. Manufacturers:
  - 1. Price
  - 2. Titus
  - 3. Tuttle and Bailey.
  - 4. Substitutions: Permitted.
- B. Type: Streamlined blades, 3/4 inch (19 mm) minimum depth, 3/4 inch (19 mm) maximum spacing, with spring or other device to set blades, vertical face. ECR type shall be 1/2 x 1/2 x 1 aluminum clear coat aluminum.
- C. Frame: 1-1/4 inch margin with concealed mounting.
- D. Fabrication: Aluminum extrusions, with factory baked enamel finish, color to be selected or clear aluminum.
- E. Damper: Integral, gang-operated, opposed-blade type with removable key operator, operable from face. No damper required on return sidewall grilles.

## 2.6 LOUVERS ( Exterior Walls)

- A. See Architectural for type and operational type.
- B. Louvers: As specified in Section 10210. See Architectural.
- C. Louvers – storm rated for Florida product approval. Wind rated for 170 MPH. Impact not required.

## 3PART EXECUTION

### 3.1 EXAMINATION

- A. Section 01300 - Administrative Requirements: Coordination and project conditions.
- B. Verify inlet and outlet locations.
- C. Verify ceiling and wall systems are ready for installation.

### 3.2 INSTALLATION

- A. Install diffusers to ductwork with airtight connection using screws, strapping, and mastic to give airtight assembly.

- B. Install balancing dampers on duct take-off to diffusers, grilles, and registers, whether or not dampers are furnished as part of diffuser, grille, and register assembly.
- C. Paint visible portion of ductwork behind all air outlets and inlets matte black. Refer to Section 09900.

### 3.3 INTERFACE WITH OTHER PRODUCTS

- A. Check location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement. Refer to Architect's reflected ceiling plan for exact placement. Separate all supply and return on maximum spacing when possible. Supply air to remain as close to Mechanical Plan placement as possible.

END OF SECTION



## SECTION 23 73 00

### AIR HANDLING UNITS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes modular factory fabricated air-handling units and accessories.
- B. Related Sections:
  - 1. Division 3 - Cast-In-Place Concrete: Execution requirements for housekeeping pads specified by this section.
  - 2. Section 230700 - Mechanical Insulation: Product requirements for insulation for placement by this section.
  - 3. Section 230548 - Vibration Isolation: Product requirements for vibration isolators for placement by this section.
  - 4. Section 232116 - Hydronic Piping: Product requirements for piping by this section.
  - 5. Section 233300- Duct Accessories: Product requirements for flexible duct connections for placement by this section.
  - 6. Division 26 - Electrical: Execution and product requirements specified by this division.

##### 1.2 REFERENCES

- A. American Bearing Manufacturers Association:
  - 1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
  - 2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- B. Air Movement and Control Association International, Inc.:
  - 1. AMCA 99 - Standards Handbook.
  - 2. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
  - 3. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
  - 4. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
  - 5. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.
- C. Air-Conditioning and Refrigeration Institute:
  - 1. ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.
  - 2. ARI 430 - Central-Station Air-Handling Units.
  - 3. ARI 610 - Central System Humidifiers for Residential Applications.
  - 4. ARI Guideline D - Application and Installation of Central Station Air-Handling Units.
- D. National Electrical Manufacturers Association:
  - 1. NEMA MG 1 - Motors and Generators.
- E. Sheet Metal and Air Conditioning Contractors:
  - 1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.
- F. Underwriters Laboratories Inc.:
  - 1. UL 900 - Air Filter Units.
  - 2. UL - Fire Resistance Directory.

### 1.3 SUBMITTALS

- A. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
- B. Product Data, Submit the following:
  - 1. Published Literature: Indicate capacities, ratings, gages and finishes of materials, and electrical characteristics and connection requirements.
  - 2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.
  - 3. Fans: Performance and fan curves with specified operating point plotted, power, RPM.
  - 4. Sound Power Level Data: Fan outlet and casing radiation at rated capacity.
  - 5. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring. Indicate factory installed and field installed wiring.
- C. Manufacturer's Installation Instructions: Submit.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

### 1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years experience approved by manufacturer.

### 1.6 PRE-INSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing work of this section.

### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Accept units and components on site in factory protective containers, with factory shipping skids and lifting lugs. Inspect for damage.
- B. Protect units from weather and construction traffic by storing in dry, roofed location.

### 1.8 WARRANTY

- A. Furnish five year parts and labor manufacturer warranty for air handling units.

## 1.9 EXTRA MATERIALS

- A. Furnish two extra sets for each unit of fan belts and filters at the end of one-year warranty.
- B. Provide two sets of fan belts and filters for each for each and all air handling equipment at Final Acceptance.
- C. Provide a total of five sets of filters for new and existing AHU's.

## PART 2 - PRODUCTS

### 2.1 AIR HANDLING UNITS

- A. Manufacturers:
  - 1. American Standard Inc./Trane.
  - 2. McQuay.
  - 3. York International
  - 4. Carrier.
  - 5. Substitutions shall be considered.
- B. Configuration: Fan section, fan and coil section plus accessories, including:
  - 1. Hot water re-heat coil, pre heat coil.
  - 2. Cooling coil section.
  - 3. Filter section or
  - 4. Combination filter/mixing box section.
  - 5. Mixing box section.
  - 6. Vertical or horizontal as indicated on plans.
  - 7. Face and bypass dampers for AHU 8-1 only.
- C. Performance Base: Sea level pressure or altitude.
- D. Fabrication: Conform to AMCA 99 and ARI 430.

### 2.2 CASING

- A. Channel base and pan of welded steel. Assemble sections with gaskets and bolts.
- B. Outside Casing Minimum thickness:
  - 1. Aluminum: 0.063 thick.
  - 2. Steel: 0.06 inch thick – painted.
  - 3. Galvanized Steel: 0.0635 inch.
  - 4. Stainless Steel: 0.0625 thick.
- C. Inside Casing:
  - 1. Galvanized Steel: Perforated on Inside Service Units, 0.0276 inch thick with Adsil or Sea Coast coating.

- D. Floor Plate:
  - 1. Galvanized Steel: .130 inch thick on Inside Air Units – Adsil coated.
- E. Insulation: Neoprene coated, glass fiber, applied to internal surfaces with adhesive and weld pins with exposed edges of insulation coated with adhesive.
  - 1. 'K' ('Ksi') factor at 75 degrees F (42 degrees C): Maximum 0.26 Btuh inch/ sq ft/ degrees F (0.037 W/m/Degree K).
  - 2. Density: 2 inch thick, 3 lbs/cu ft.
  - 3. 2" foamed in place between inner and outer walls.
- F. Finish: Baked enamel manufacturers standard paint on exterior and inside with Adsil coating inside and out for RTAH. Standard finish for all indoor AHUs.
- G. Inspection Doors: 18 x 22 inch (minimum) of galvanized steel for flush mounting, with gasket, latch, and handle assembly Air Handling Units.
- H. Drain Pans: Single thickness stainless steel with insulation with welded corners. Cross break and pitch to drain connection. Furnish drain pans under cooling coil section. Provide auxiliary galvanized drain pans with shut off switches, to be interlocked with controls on suspended AHU's above ceilings, existing and new.
- I. Strength: Furnish structure to brace casings for suction pressure of 2.5 inch wg, with maximum deflection of 1 in 200.
- J. Dampers: Adjustable, of stainless steel, 4 inch deep with plenum, nylon bearings, 1/2 inch (13 mm) mesh, 0.04 inch stainless steel wire bird screen in stainless steel frame, and bearing AMCA Certified Ratings Seal in accordance with AMCA 500. Furnish adjustable dampers with hollow vinyl bulb edging on blades and foam side stops to limit leakage to maximum 2 percent at 4 inch wg (1 kPa) differential pressure when sized for 200 fpm (10 m/s) face velocity.

## 2.3 FANS

- A. Type: Forward curved, double width, double inlet, centrifugal fan.
- B. Performance Ratings: Conform to AMCA 210 and label with AMCA Certified Rating Seal.
- C. Sound Ratings: AMCA 301, tested to AMCA 300 and label with AMCA Certified Sound Rating Seal.
- D. Bearings: Self-aligning, grease lubricated, ball or roller bearings with lubrication fittings extended to exterior of casing with plastic tube and grease fitting rigidly attached to casing. Roof top units shall have aluminum tubing.
- E. Mounting: Locate fan and motor internally on welded steel base coated with corrosion resistant paint. Factory mount motor on slide rails. Furnish access to motor, drive, and bearings through removable casing panels or hinged access doors. Mount base on vibration isolators.
- F. Fan Modulation: Variable Frequency Drive. Refer to Division 26 for type only used on inside service AHUs.
- G. Flexible Connection: Separate unit from connecting ductwork.



## 2.4 BEARINGS AND DRIVES

- A. Bearings: Pillow block type, self-aligning, grease-lubricated L-10 life at 120,000 hours.
- B. Shafts: Solid, hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.
- C. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, bored to fit shafts, and keyed. Variable and adjustable pitch sheaves for motors 15 hp and under selected so required rpm is obtained with sheaves set at mid-position; fixed sheave for 20 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of motor.

## 2.5 COILS

- A. Casing with access to both sides of coils. Enclose coils with headers and return bends fully contained within casing. Slide coils into casing through removable end panel with blank off sheets and sealing collars at connection penetrations.
- B. Drain Pans: 24 inch (600 mm) downstream of coil and down spouts for cooling coil banks more than one coil high. Pans to be stainless steel.
- C. Eliminators: Three break of Type 304 stainless steel or PVC, mounted over drain pan.
- D. Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with ARI 410. 100% Outside Air Coils shall be provided with Sea Coast coating equal to Adsil or constructed with copper fins and tubes.
- E. Fabrication:
  - 1. Tubes: 5/8 inch (16 mm) OD seamless copper expanded into fins, brazed joints.
  - 2. Fins: Aluminum - Copper on 100% Outside Air Units if not coated.
  - 3. Casing: Die formed channel frame of galvanized steel, provide stainless steel or aluminum on 100% Outside Air Units.
- F. Water Cooling Coils:
  - 1. Headers: Cast iron, seamless copper tube with brazed joints.
  - 2. Configuration: Drainable, with threaded plugs for drain and vent; threaded plugs in return bends and in headers opposite each tube.

## 2.6 FILTERS

- A. Filter Box: Section with filter guides, access doors from both sides, for side loading with gaskets and blank-off plates.
- B. Filter Media: UL 900 listed, Class I, approved by Engineer.
- C. Angle High Capacity: 2 inches (50 mm) deep disposable extended area panel filters (RTAH and 100% outside air AHUs). Provide MERV 13 minimum filter rating.
- D. Extended Surface: Filter box with holding frames and blank-off sheets, extended surface high efficiency media filters with MERV 13 efficiency (inside AHUs).

- E. Provide a minimum of two sets of filters for each AHU at Final Acceptance. Total of five (5) sets of filters to be provided for new and existing AHU designated units only.
- F. Contractor or Unit Manufacturer shall furnish full maintenance for filter change out and servicing all equipment for one year period to include all labor and parts. Filters to be changed on quarterly basis. Provide additional filters as required.

## 2.7 DAMPERS

- A. Mixing Boxes: Section with outside and return air dampers of stainless steel and edge seals in stainless steel frame, with stainless steel axles in self-lubricating nylon bearings, in opposed blade arrangement with damper blades positioned across short air opening dimension.
- B. Damper Leakage: Maximum 2 percent at 4 inch wg (1 kPa) differential pressure when sized for 2000 fpm (10 m/s) face velocity.
- C. Damper Actuators: Furnish factory installed electronic damper actuators for outside air dampers on Air Handling Units
- D. Face and Bypass dampers shall comply with requirements as noted above.

## 2.8 CONTROLS

- A. Controls: Refer to Controls Section.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install in accordance with ARI 430.
- B. Install flexible connections between RTAH or AHU and inlet and discharge ductwork. Install metal bands of connectors parallel with minimum 1 inch (25 mm) flex between ductwork and fan while running.
- C. Install assembled units with vibration isolators. Install isolated fans with resilient mountings and flexible electrical leads. Install restraining snubbers as required. Adjust snubbers to prevent tension in flexible connectors when fan is operating.
- D. Install floor mounted units on concrete housekeeping pads at least 3-1/2 inches (87 mm) high and 6 inches (150 mm) wider than unit unless noted otherwise.
- E. Provide sheaves required for final air balance.

### 3.2 MANUFACTURER'S FIELD SERVICES

- A. Furnish initial start-up and shutdown during first year of operation, including routine servicing and checkout on quarterly basis.

3.3 CLEANING

- A. Vacuum clean coils and inside of unit cabinet.
- B. Install new throwaway filters in units at Substantial Completion.

3.4 DEMONSTRATION

- A. Demonstrate unit operation and maintenance.
- B. Furnish services of manufacturer's technical representative for two 8 hour days to instruct Owner's personnel in operation and maintenance of units. Schedule training with Owner, provide at least 7 days notice to Owner of training date.

3.5 PROTECTION OF FINISHED WORK

- A. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION



## SECTION 23 81 26

### SPLIT SYSTEM AIR CONDITIONING UNITS (MINI SPLIT)

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Air handling unit. (Wall & Inline type)
  - 2. Heat pump unit. (Single and Multi Zone)
- B. Related Sections:
  - 1. Section 232300 - Refrigerant Piping: Execution requirements for connection to refrigerant piping specified by this section.
  - 2. Section 230548- Vibration Isolation:: Vibration isolators.
  - 3. Section 232116 - Hydronic Piping: Execution requirements for connection to drain piping specified by this section.

##### 1.2 REFERENCES

- A. Air-Conditioning and Refrigeration Institute:
  - 1. ARI 210/240 - Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
  - 2. ARI 270 - Sound Rating of Outdoor Unitary Equipment.
  - 3. ARI 340/360 - Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.
  - 4. ARI 365 - Commercial and Industrial Unitary Air-Conditioning Condensing Units.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
  - 1. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- C. National Electrical Manufacturers Association:
  - 1. NEMA MG 1 - Motors and Generators.
- D. National Fire Protection Association:
  - 1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

##### 1.3 SUBMITTALS

- A. Division 1 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data indicating:
  - 1. Cooling and heating capacities.
  - 2. Dimensions.
  - 3. Weights.
  - 4. Rough-in connections and connection requirements.
  - 5. Electrical requirements with electrical characteristics and connection requirements.
  - 6. Controls.
  - 7. Accessories.

- C. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- E. Manufacturer's Field Reports: Submit start-up report for each unit.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Division 1 - Execution Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of controls installed remotely from units.
- C. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

#### 1.5 QUALITY ASSURANCE

- A. Performance Ratings: 7.0, Seasonal Energy Efficiency Rating (SEER) not less than prescribed by ASHRAE 90.1 when used in combination with compressors and evaporator coils.
- B. Cooling and Heating Capacity: Rate in accordance with ARI 365.
- C. Sound Rating: Measure in accordance with ARI 270.
- D. Insulation and adhesives: Meet requirements of NFPA 90A.
- E. Maintain one copy of each document on site.

#### 1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

#### 1.7 PRE-INSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing work of this section.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Accept units and components on site in factory protective containers, with factory shipping skids and lifting lugs. Inspect for damage.
- B. Comply with manufacturer's installation instruction for rigging, unloading and transporting units.
- C. Protect units from weather and construction traffic by storing in dry, roofed location.

## 1.9 COORDINATION

- A. Coordinate installation of condensing units with roof structure.
- B. Coordinate installation of high wall fan coil units with building structure.

## 1.10 WARRANTY

- A. Furnish five year manufacturers warranty for compressors.

## 1.11 MAINTENANCE SERVICE

- A. Furnish service and maintenance of equipment for one year from Date of Substantial Completion. Include maintenance items as shown in manufacturer's operating and maintenance data, including filter replacements, fan belt replacement, and controls checkout, adjustments and Freon adjustment or charge. Freon to be included.
- B. Furnish 24-hour emergency service on breakdowns and malfunctions for this maintenance period. Furnish capability of response time within 8 hours.

## 1.12 MAINTENANCE MATERIALS

- A. Furnish one set for each unit of filters.

## PART 2 - PRODUCTS

### 2.1 DUCTLESS SPLIT SYSTEM AIR CONDITIONING UNITS

- A. Product Description: Split system consisting of fan coil unit and heat pump unit including cabinet, evaporator fan, refrigerant cooling coil, compressor, refrigeration circuit, condenser, air filters, controls, air handling unit accessories, condensing unit accessories, reversing valve, and refrigeration specialties. Also include branch selector devices as needed. If condenser can be provided with multiple ports, branch selector devices may be deleted.

### 2.2 FAN COIL UNIT

- A. General: Indoor, direct-expansion, ducted above ceiling or wall-mounted fan coil. Unit shall be complete with cooling coil, fan, fan motor, piping connectors, electrical controls, microprocessor control system, and integral temperature sensing. Unit shall be furnished with integral wall-mounting bracket and mounting hardware or hanging mounts for suspension of unit. All units to be provided with condensate pump.
- B. Unit Cabinet: Cabinet discharge and inlet grilles shall be attractively styled, high-impacted polystyrene. Cabinet shall be fully insulated for improved thermal and acoustic performance. In line unit to have duct collars for both supply and return ductwork.
- C. Fans
  - 1. Fan shall be tangential direct-drive-blower type with air intake at the upper front face of the unit and discharge at the bottom front across flow for inline units. Automatic, motor-driven vertical air sweep shall be provided standard for wall mounts.

2. Air sweep operation shall be user selectable. Horizontal direction may be manually adjusted (using remote controller) and vertical air sweep may be manually set. Does not apply to inline units.
- D. Coil
1. Coil shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion. A drip pan under the coil shall have a drain connection for hose attachment to remove condensate. Condensate pan shall have internal trap and auxiliary drip pan under coil header. Provide auxiliary galvanized drain pan under inline units with float shut off.
- E. Motors shall be open drip-proof, permanently lubricated ball bearing with inherent overload protection. Fan motors shall be 2-speed.
- F. Controls shall consist of a microprocessor-based control system, which shall control space temperature, determine optimum fan speed, and run self-diagnostics. The temperature control range shall be from 64°F to 84°F. The unit shall have the following functions as a minimum.
1. An automatic restart after power failure at the same operating conditions as at failure.
  2. A timer function to provide a minimum 24-hour timer cycle for system Auto. Start/Stop.
  3. Temperature-sensing controls shall sense return-air temperature. Indoor-air high discharge temperature shutdown shall be provided.
  4. Indoor coil freeze protection.
  5. Wireless infrared remote control to enter set points and operating conditions.
  6. Auto Stop features shall have integral setback control.
  7. Automatic airt sweep control to provide on or off activation of air sweep louvers.
  8. Defrost mode for outdoor unit.
  9. Fan only operation shall provide room air circulation when no cooling is required.
  10. Diagnostics shall provide continuous checks of unit operation and warn of possible malfunctions. Error messages shall be displayed at the unit and at the remote controller.
  11. Fan speed control shall be user-selectable: high, low or microprocessor automatic operation during all operating modes.
  12. A time delay shall prevent compressor restart in less than 3 minutes.
- G. Filters: Units shall have filter track with factory-supplied cleanable filters. Service shall include cleaning filters on all units. Inline unit filters to be changed and shall be MERV 13 minimum.
- H. Electrical Requirements: See Division 26 requirements. Power and control connections shall have terminal block connections.
- I. Refrigerant Lines: The fan coil units shall have rotatable refrigerant lines for penetration through the walls using flare connections. All units shall have flare connections and a 90-degree suction elbow shall be provided for rear connection.

## 2.3 HEAT PUMP UNIT

- A. General: Factory assembled and tested air cooled condensing units, consisting of casing, compressors, condensers, coils, condenser fans and motors, and unit controls.
- B. Unit Casings: Exposed casing surfaces constructed of galvanized steel with manufacturer's standard baked enamel finish. Designed for outdoor installation and complete with weather protection for components and controls, and complete with removable panels for required access to compressors, controls, condenser fans, reversing valve, motors, and drives.



- C. Compressor: Single refrigeration circuit with rotary or hermetic reciprocating type compressor, resiliently mounted, with positive lubrication, and internal motor overload protection.
- D. Condenser Coil: Constructed of copper tubing mechanically bonded to aluminum or copper fins, factory leak and pressure tested.
- E. Controls: Furnish operating and safety controls including high and low pressure cutouts. Control transformer. Furnish magnetic contactors for compressor and condenser fan motors.
- F. Condenser Fans and Drives: Direct drive propeller fans statically and dynamically balanced. Wired to operate with compressor. Permanently lubricated ball bearing type motors with built-in thermal overload protection. Furnish high efficiency fan motors.
- G. Condensing Unit Accessories: Furnish the following accessories:
  - 1. Time delay relay.
  - 2. Anti-short cycle timer.
  - 3. Disconnect switch.
  - 4. Vibration isolators.
  - 5. Coil with corrosion resistant coating capable of withstanding salt spray test of 1000 hours in accordance with ASTM B117.
  - 6. Condenser Coil Guard: Condenser fan openings furnished with PVC coated steel wire safety guards.
  - 7. Suction and discharge pressure gauges.
- H. Refrigeration specialties: Furnish the following for each circuit:
  - 1. Charge of compressor oil.
  - 2. Holding charge of refrigerant.
  - 3. Replaceable core type filter drier.
  - 4. Shut-off valves on suction and liquid piping.
  - 5. Liquid line solenoid valve.
  - 6. Charging valve.
  - 7. Oil level sight glass.
  - 8. Hot gas muffler.
  - 9. Pressure relief device.
- I. Refrigerant: Furnish charge of refrigerant R-410.

## 2.4 CONTROLS

- A. Thermostat: Remote space thermostat with single stage cooling/heating. Furnish system selector switch off/cool/heat/fan. All units to be interfaced with facility existing EMCS for OFF/ON scheduling of unit. Space and equipment shall be monitored for alarm purposes.

## 2.5 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Electrical Characteristics: In accordance with Division 26.
- B. Disconnect Switch: Factory mounted, non-fused type, interlocked with access door, accessible from outside unit, with power lockout capability.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify roof for heat pump unit is ready for unit installation.

### 3.2 INSTALLATION - AIR HANDLING UNIT

- A. Install fan coil unit on wall.
- B. Install condensate piping and route from fan coil to condensate drainage system. Insulate condensate piping with 1 inch pipe insulation.
- C. Install components furnished loose for field mounting.
- D. Install connection to electrical power wiring in accordance with Division 26.
- E. Install 12 inch roof curb, cant (if required), and flashing for heat pump unit.

### 3.3 INSTALLATION - CONDENSING UNIT

- A. Install heat pump unit on concrete pad, per manufacturer's instructions. Bolt down per FMC for wind rating for coastline construction.
- B. Bolt heat pump unit to concrete pad structure in compliance with hurricane tie-down specifications set forth in the Florida Building Code, Mechanical.
- C. Install refrigerant piping from unit to heat pump unit. Install refrigerant specialties furnished with unit. Flash piping through wall for zero leakage, as detailed in Drawings.
- D. Install electrical devices furnished loose for field mounting.
- E. Install control wiring between fan coil unit, heat pump unit, and field installed accessories.
- F. Install connection to electrical power wiring in accordance with Division 26.
- G. Provide power to branch selector terminal for multi zone installation.

### 3.4 MANUFACTURER'S FIELD SERVICES

- A. Furnish initial start-up and shutdown during first year of operation, including routine servicing and checkout.

3.5 CLEANING

- A. Vacuum clean coils and inside of unit cabinet.
- B. Install new throwaway filters in units at Substantial Completion.

3.6 DEMONSTRATION

- A. Demonstrate fan coil unit operation and maintenance.
- B. Demonstrate starting, maintenance, and operation of heat pump unit.
- C. Furnish services of manufacturer's technical representative for one 8 hour day to instruct Owner's personnel in operation and maintenance of units. Schedule training with Owner, provide at least 7 days notice to Architect/Engineer of training date.

END OF SECTION



## SECTION 26 03 05

### ELECTRICAL GENERAL REQUIREMENTS

#### PART 1 GENERAL

##### 1.01 WORK INCLUDED

- A. Electrical work for this project will include all electrical work necessary to remodel portions of the existing buildings. Electrical work will include all power wiring, 120 volt and above, and certain low voltage wiring for communication systems. Power wiring will include all 120 volt power for any low voltage system including but not limited to the Fire Alarm system, Intercom system, EMCS system, CATV system and LAN/Telephone system.

##### 1.02 CONTINUOUS OPERATION

- A. All existing buildings shall be occupied throughout the duration of construction. All electrical systems shall remain in use and in operation at all times. Notify school personnel before disrupting any electrical system. Minimize all outage durations. Make temporary connections to maintain electrical systems in use when extended outages are required.

##### 1.03 APPLICABLE PUBLICATIONS

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

- A. INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

- IEEE 100                      2000 Dictionary of Electrical and Electronics Terms

- B. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- NEMA ICS 6                      1993 (Rev. 2006) Enclosures for Industrial Control and Systems

- NEMA MG 1                      2006 (Rev. 2007) Motors and Generators

- NEMA MG 10                      2001 (Rev. 2007) Energy Management Guide for Selection and Use of Polyphase Motors

- NEMA MG 11                      1977 (Rev. 2007) Energy Management Guide of Selection and Use of Single-Phase Motors

- C. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70                    2008 National Electrical Code

NFPA 101                  2006 Life Safety Code

D. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2                    2007 National Electrical Safety Code

E. CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.147    Control of Hazardous Energy (Lock Out/Tag Out)

F. FEDERAL SPECIFICATIONS (FS)

FS L-P-387                    (Rev. A) (Int Am. 2) Plastic Sheet, Laminated,  
Thermosetting (for Design Plates)

G. Florida Building Code 2007 (with 2009 Supplement)

Chapter 4 Special Occupancy, Section 423 State Requirements for Educational  
Facilities

1.04 APPLICATION

- A. This section applies to all sections of Division 26, "Electrical," of this project except as specified otherwise in each individual section.

1.05 DEFINITION OF ELECTRICAL TERMS

- A. Unless otherwise specified or indicated, electrical terms used in these specifications, and on the drawings, shall be as defined in IEEE Standard No. 100.

1.06 SUBMITTALS

- A. Obtain approval before procurement, fabrication, or delivery of items to the job site. Partial submittals will not be acceptable and will be returned without review. Submittals shall include the manufacturer's name, trade name, place of manufacture, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and paragraph reference, applicable Federal, Military, industry, and technical society publication references, and other information necessary to establish contract compliance of each item to be furnished.
- B. Shop Drawings: In addition to the requirements specified elsewhere, shop drawings shall meet the following requirements. Drawings shall be a minimum of 8.5 inches by 11 inches in size, except as specified otherwise. Drawings shall include complete

ratings information, wiring diagrams, and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to assure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. If equipment is disapproved, revise drawings to show acceptable equipment and resubmit.

- C. Manufacturer's Product Data: Submittals for each manufactured item shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts.
- D. Submit only pages which are pertinent; mark each copy of standard printed data to identify pertinent products, referenced to Specification Section and Article number. Show reference standards, performance characteristics, and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions and required clearances.
- E. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the Work. Delete information not applicable.
- F. Publication Compliance: Where equipment or materials are specified to conform to industry and technical society publications of organizations such as American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), and Underwriters Laboratories Inc. (UL), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears. In lieu of the label or listing, submit a certificate from an approved independent testing organization, adequately equipped and competent to perform such services, stating that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's publication.
- G. Certificates of Compliance: Submit manufacturer's certifications as required on products, materials, finish, and equipment indicated in the technical sections. Certifications shall be documents prepared specifically for this contract. Preprinted certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the specified material." Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be

printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance.

#### 1.07 WARRANTY

- A. All equipment, material, accessories and installation shall carry a guarantee against defects and workmanship for a period of one year from the date of acceptance. Each system as a whole, and in all its parts, shall be guaranteed to function correctly up to the specified capacity. Should a system, or any part thereof, fail to meet the performance requirements, necessary replacements, alternations or repairs and required labor shall be made to bring performance up to specified requirements. Building construction finishes damaged or marred shall be restored to the satisfaction of the Owner's representative. All of the above described shall be done without cost to the Owner.
- B. Provide a warranty statement to be included in all Operations and Maintenance Manuals.
- C. Provide extended manufacturer's warrantees where required by specific technical sections of these specifications.
- D. Where extended guarantees are called for herein, provide a warranty statement detailing the extended guarantees and length coverage for each required system(s) to be included in all Operations and Maintenance Manuals.
- E. Warranty maintenance shall be provided by the Contractor during his normal working hours at no expense to the Owner.
- F. This warranty shall not apply if damage is caused by abuse, accident, improper operation, or negligence.

#### 1.08 OPERATION AND MAINTENANCE MANUAL

- A. Submit as required for systems and equipment indicated in the technical sections. Furnish five copies, bound in hardback binders or an approved equivalent. Furnish one complete manual prior to performance of systems or equipment tests, and furnish the remaining manuals prior to contract completion. Inscribe the following identification on the cover: the words "OPERATION AND MAINTENANCE MANUAL," the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment. Include a table of contents and assemble the manual to conform to the table of contents, with the tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in. The manual shall include:
  - 1. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the system or equipment.



2. A control sequence describing startup, operation, and shutdown.
3. Description of the function of each principal item of equipment.
4. Installation and maintenance instructions.
5. Safety precautions.
6. Diagrams and illustrations.
7. Testing methods.
8. Performance data.
9. Lubrication schedule including type, grade, temperature range, and frequency.
10. Parts list: The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
11. Appendix: List qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.

#### 1.09 POSTED OPERATING INSTRUCTIONS

- A. Furnish approved operating instructions for systems and equipment indicated in the technical sections for use by operation and maintenance personnel. The operating instructions shall include wiring diagrams, control diagrams, and control sequence for each principal system and equipment. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions as directed. Attach or post operating instructions adjacent to each principal system and equipment including startup, proper adjustment, operating, lubrication, shutdown, safety precautions, procedure in the event of equipment failure, and other items of instruction as recommended by the manufacturer of each system or equipment. Provide weather-resistant materials or weatherproof enclosures for operating instructions exposed to the weather. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

#### 1.10 DELIVERY AND STORAGE

- A. Handle, store, and protect equipment and materials in accordance with the manufacturer's recommendations and with the requirements of NFPA 70B, Appendix I, titled "Equipment Storage and Maintenance During Construction." Replace damaged or defective items with new items.

#### 1.11 CATALOGED PRODUCTS/SERVICE AVAILABILITY

- A. Materials and equipment shall be current products by manufacturers regularly engaged in the production of such products. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The 2-year period shall be satisfactorily completed by a product for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished. The equipment items shall be

supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

#### 1.12 MANUFACTURER'S INSTRUCTIONS

- A. Where installation procedures or any part thereof are required to be in accordance with manufacturer's instructions, furnish printed copies of the instructions prior to installation. Installation of the item shall not proceed until instructions are received. Failure to furnish instructions shall be cause for rejection of the equipment or material.
- B. Comply with instructions in full detail, including each step in sequence. Should instructions conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.

#### 1.13 MOTORS AND MOTOR CONTROLS FOR MECHANICAL EQUIPMENT

- A. The electrical components of mechanical equipment, such as motors, motor starters, control or push-button stations, float or pressure switches, solenoid valves, and other devices functioning to control mechanical equipment, and control wiring and conduit for circuits rated 100 volts or less, are specified in the section covering the associated mechanical equipment, rather than in Division 26. The interconnecting power wiring and conduit, control wiring rated 120 volts (nominal) and conduit, and the electrical power circuits shall be furnished and installed under Division 26.

#### 1.14 AS BUILT DRAWINGS

- A. Maintain one complete set of drawings on the job site for the purpose of recording changes and modifications in the Contract Documents. Do not use the job set for any purpose except entry of new data.
- B. Using an erasable colored pencil (not ink or indelible pencil), clearly and accurately record all changes to the construction. Locate all conduits, circuits, junction boxes, pull boxes, panels, starters and similar items where different from that shown on the Contract Documents and where not shown. Clearly indicate the location of any junction containing splices, taps or terminations. Date all entries.
- C. At a time nearing the completion of the work, complete all changes to the job set of drawings and forward the drawings to the Architect/Engineer for review and approval.
- D. The work shall not be considered substantially complete until As-Built Drawings are submitted for review.

### PART 2 PRODUCTS

#### 2.01 MATERIALS AND EQUIPMENT

- A. All materials, equipment, and devices shall, as a minimum, meet the requirements of UL where UL standards are established for those items, and the requirements of NFPA 70. All items shall be new unless specified or indicated otherwise.

## PART 3 EXECUTION

### 3.01 MATERIAL AND EQUIPMENT

- A. All material and equipment shall, as a minimum, be installed in accordance with NFPA 70, National Electrical Code.

### 3.02 PAINTING OF EQUIPMENT

- A. Factory Applied: Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test, except equipment specified to meet requirements of ANSI C37.20 shall have a finish as specified in ANSI C37.20.
- B. Field Applied: Paint electrical equipment as required to match finish or to meet safety criteria.

### 3.03 AS-BUILT DRAWINGS

- A. Submit As-Built Drawings for review and approval at or before Substantial Completion Inspection.

END OF SECTION



SECTION 26 03 07

MINOR ELECTRICAL DEMOLITION FOR REMODELING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical demolition.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Materials and Equipment for Patching and Extending Work: As specified in individual Sections.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements and circuiting arrangements are as shown on Drawings.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.
- C. Demolition Drawings are based on casual field observation. Report discrepancies to Architect/Engineer before disturbing existing installation.
- D. Beginning of demolition means installer accepts existing conditions.

3.02 PREPARATION

- A. Disconnect electrical systems scheduled for removal.
- B. Coordinate utility service outages with Utility Company.
- C. Provide temporary wiring and connections to maintain existing systems (e.g. fire alarm, intercom, etc.) in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- D. Existing Electrical Service: Maintain existing system in service at all times. Obtain permission from Owner at least 24 hours before making any change to existing systems. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Demolish and extend existing electrical work under provisions of this Section.

- B. Remove, relocate, and extend existing installations to accommodate new construction.
- C. Remove abandoned wiring to source of supply.
- D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- E. Disconnect and remove abandoned luminaries. Remove brackets, stems, hangers, and other accessories.
  
- F. Repair adjacent construction and finishes damaged during demolition and extension work.
- G. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

END OF SECTION

SECTION 26 05 19

WIRE AND CABLE

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Building wire.
- B. Metal Clad Cable
- C. Wiring connections and terminations.

1.02 REFERENCES

- A. NEMA WC 3 - Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
- B. NEMA WC 5 - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

1.03 SUBMITTALS

- A. Submit shop drawings and product data under the provisions of Section 26 03 05.
- B. Submit manufacturer's instructions.

PART 2 PRODUCTS

2.01 BUILDING WIRE

- A. Thermoplastic-insulated Building Wire: NEMA WC 5.
- B. Feeders and Branch Circuits Larger Than 6 AWG: Copper, stranded conductor, 600 volt insulation, THWN.
- C. Feeders and Branch Circuits 6 AWG and Smaller: Copper conductor, 600 volt insulation, THWN 6 and 8 AWG, stranded conductor; smaller than 8 AWG, solid conductor.
- D. Control Circuits: Copper, stranded conductor 600 volt insulation, THW.

2.02 REMOTE CONTROL AND SIGNAL CABLE

- A. Control Cable for Class 1 Remote Control and Signal Circuits: Copper conductor, 600 volt insulation, rated 75 degree C, individual conductors twisted together and covered with aluminum sheath, and overall PVC jacket.

- B. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 75 degree C, individual conductors twisted together and covered with a PVC jacket; UL listed.

## 2.03 METAL CLAD CABLE

- A. Conductor: Copper. Do not use aluminum.
- B. Insulation Voltage Rating: 600 volts.
- C. Insulation Temperature Rating: 75 degrees C.
- D. Insulation Material: Thermoplastic.
- E. Armor Material: Steel.
- F. Armor Design: Corrugated tube.
- G. Jacket: None.

## PART 3 EXECUTION

### 3.01 GENERAL WIRING METHODS

- A. Use no wire smaller than 12 AWG for power and lighting circuits, and no smaller than 14 AWG for control wiring.
- B. Use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 75 feet and 277 volt branch circuit home runs longer than 200 feet.
- C. Place an equal number of conductors for each phase of a circuit in same raceway or cable.
- D. Splice only in junction or outlet boxes.
- E. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- F. Make Conductor lengths for parallel circuits equal.
- G. Provide a separate neutral conductor for every circuit requiring a neutral. "Common" neutrals shall not be installed.
- H. Provide a separate grounding conductor in every raceway. Provide a separate grounding conductor for every feeder and branch circuit. Multiple ground conductors are required where more that one circuit is installed in a common raceway. "Common" ground conductors shall not be installed.

### 3.02 WIRING INSTALLATION IN RACEWAYS



- A. Pull all conductors into a raceway at the same time. Use UL listed wire pulling lubricate for pulling 4 AWG and larger wires.
- B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.
- C. Completely and thoroughly swab raceway system before installing conductors.
- D. Use solderless pressure connectors with insulating covers for copper wire splices and taps, 8 AWG and smaller. For 10 AWG and smaller, use insulated spring wire connectors with plastic caps.
- E. Use compression connectors for copper wire splices and taps, 6 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value of conductor.
- F. Thoroughly clean wires before installing lugs and connectors.
- G. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.
- H. Terminate spare conductors with electrical tape.
- I. All splices, taps and terminations of any Fire Alarm conductors shall be made using binder head screw terminals only.

### 3.03 CABLE WIRING TECHNIQUES

- A. Wiring in raceways may be converted to metal clad cable above accessible ceilings. Do not install metal clad cable in walls, under floors or underground or above hard ceilings.
- B. Protect exposed cable from damage.
- C. Support cables above accessible ceiling, using spring metal clips to support cables from structural members. Do not rest cable on ceiling panels.
- D. Use suitable cable fittings and connectors.

### 3.04 WIRE COLOR

- A. General
  - 1. For wire sizes 10 AWG and smaller, install wire colors in accordance with the following:
    - a. Black, red, and blue for circuits at 120/208 volts single or three phase.
  - 2. For wire sizes 8 AWG and larger, identify wire with colored tape at terminals, splices and boxes. Colors are as follows:
    - a. Black, red, and blue for circuits at 120/208 volts single or three phase.

- B. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number.
- C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.
- D. Feeder Circuit Conductors: Uniquely color code each phase.
- E. Ground Conductors:
  - 1. For 6 AWG and smaller: Green.
  - 2. For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

### 3.05 FIELD QUALITY CONTROL

- A. Inspect wire and cable for physical damage and proper connection.
- B. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.

### 3.06 WIRE AND CABLE INSTALLATION SCHEDULE

- A. Use building wire in raceways in all exposed locations and in all locations concealed by permanently installed materials.
- B. Metal clad cable may be used above accessible ceilings only.

END OF SECTION

## SECTION 26 05 26

### SECONDARY GROUNDING

#### PART 1 GENERAL

##### 1.01 WORK INCLUDED

- A. Power system grounding.
- B. Communication system grounding.
- C. Electrical equipment and raceway grounding and bonding.
- D. Grounding Systems Testing.

##### 1.02 SYSTEM DESCRIPTION

- A. Ground the electrical service system neutral at service entrance equipment to supplementary grounding electrodes.
- B. Bond together system neutrals, service equipment enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and plumbing systems.

##### 1.03 SUBMITTALS

- A. Submit shop drawings under provisions of Section 26 03 05.
- B. Submit grounding electrode test results in tabulated format at substantial completion
- C. Indicate location of system grounding electrode connections, and routing of grounding electrode conductor.

##### 1.04 QUALITY ASSURANCE

- A. Compliance: Testing shall be accomplished by an independent testing firm and comply to the following standards:
  - 1. NEMA
  - 2. NETA
  - 3. NFPA
  - 4. IEEE
- B. Qualification: The testing firm shall be an independent testing organization which can function as an unbiased testing authority, professionally independent of the manufacturers, supplier, and installers of equipment or systems evaluated by the testing firm.
- C. Experience: The testing firm shall be regularly engaged in the testing of electrical

equipment devices, installations, and systems.

- D. Accreditation: The testing firm shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907, or be a Full Member Company of the International Electrical Testing Association.
- E. Certification: The lead, on-site, technical person shall be currently certified by the International Electrical Testing Association (NETA) or National Institute for Certification in Engineering Technologies (NICET) in electrical power distribution system testing.
- F. Personnel: The testing firm shall utilize engineers and technicians who are regularly employed by the firm for testing services.
- G. Proof of Qualifications: The testing firm shall submit proof of the above qualifications when requested.

## PART 2 PRODUCTS

### 2.01 MATERIALS

- A. Ground Rods: Copper-encased steel, 3/4 inch diameter, minimum length 10 feet.

### 2.02 EQUIPMENT

- A. Instruments: Supply all instruments required to read and record data. Calibration date shall be submitted on test reports.
- B. Adjustments: Adjust system to operate at the required performance levels within all tolerances as required NETA standards.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Provide a separate, insulated equipment grounding conductor in every raceway. Provide a separate grounding conductor for every feeder and branch circuit. Multiple ground conductors are required where more than one circuit is installed in a common raceway. "Common" ground conductors shall not be installed. Terminate each end on a grounding lug, bus, or bushing.
- B. Provide three (3) twenty foot (20) supplementary grounding electrodes a minimum of six (6) feet apart near the service entrance location. Connect the electrodes to the service system using copper conductor in nonmetallic conduit in accordance with the National Electrical Code.
- C. Connect grounding electrode conductors to supplementary grounding electrodes using exothermically welded connections after grounding electrode test are complete.

- D. Connect grounding conductors to interior metal water pipes using suitable ground clamps, using copper conductor in accordance with the National Electrical Code.
- E. Use minimum 6 AWG copper conductor for communications service grounding conductor. Leave 10 feet slack conductor at terminal board.

### 3.02 FIELD QUALITY CONTROL

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- B. Electrode Ground: The resistance of all electrodes (main services, generators, transformer, etc.) shall not exceed 25 ohms and shall be measured by the testing firm before conductors are connected and before equipment is placed in operation. Any measurement exceeding 5 ohms shall be reported to the Owner and direction from the Owner shall be received before any final connections are made. Testing shall be performed on all grounding electrode installations. Testing shall be conducted by the three (3) point fall-of-potential method in accordance with IEEE Standard No. 81-1983, Section 9.04. Ground tests shall be performed on each electrode before conductor connections are made. If measured resistance is below 5 ohms all conductors shall be connected and the entire grounding electrode system shall be tested. Submit all ground test readings in tabulated format within one week of ground test(s).
- C. Electrical Contractor shall engage an independent testing company to perform the ground testing. The Electrical Contractor shall not perform the ground testing.

END OF SECTION

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## SECTION 26 05 29

### SUPPORTING DEVICES

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Conduit and equipment supports.
- B. Anchors and fasteners.

##### 1.02 REFERENCES

- A. NECA - National Electrical Contractors Association.
- B. ANSI/NFPA 70 - National Electrical Code.

##### 1.03 SUBMITTALS

- A. Submit under provisions of Section 26 03 05.
- B. Product Data: Provide manufacturer's catalog data for fastening systems.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

##### 1.04 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

#### PART 2 PRODUCTS

##### 2.01 PRODUCT REQUIREMENTS

- A. Materials and Finishes: Provide adequate corrosion resistance.
- B. Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.
- C. Anchors and Fasteners:

1. Concrete Structural Elements: Use precast insert system, expansion anchors and preset inserts.
2. Steel Structural Elements: Use beam clamps, spring steel clips and welded fasteners.
3. Concrete Surfaces: Use expansion anchors.
4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts.
5. Solid Masonry Walls: Use expansion anchors and preset inserts.
6. Sheet Metal: Use sheet metal screws.
7. Wood Elements: Use wood screws.

## 2.02 STEEL CHANNEL

- A. Description: Galvanized steel in exterior locations, painted steel for interior applications.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation".
- C. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.
- D. Do not use powder-actuated anchors.
- E. Do not drill or cut structural members.
- F. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
- G. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- H. In wet and damp locations use steel channel supports to stand cabinets and panelboards one inch off wall.
- I. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
- J. Use galvanized steel channel to construct electrical equipment supports for all exterior mounted equipment that cannot be fastened to a building wall. Use a minimum of two (2) vertical channels with additional horizontal channels where multiple disconnects, starters or where a panelboard is installed. Set vertical members in concrete foundation



or anchor to equipment slabs with galvanized angle brackets and 3/8 stainless steel bolts and expansion anchors, minimum of 2 per member.

END OF SECTION



## SECTION 26 05 32

### CONDUIT

#### PART 1 GENERAL

##### 1.01 WORK INCLUDED:

- A. Rigid metal conduit and fittings.
- B. Electrical metallic tubing and fittings.
- C. Electrical non-metallic conduit
- D. Flexible metal conduit and fittings.
- E. Liquidtight flexible metal conduit and fittings.
- F. Surface metal raceways.

##### 1.02 REFERENCES

- A. ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated.
- B. ANSI C80.3 - Electrical Metallic Tubing, Zinc-Coated.
- C. ANSI/NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.
- D. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
- E. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

##### 1.03 SUBMITTALS

- A. Submit under provisions of Section 26 03 05.
- B. Product Data: Provide for all conduit types, fittings, conduit bodies, surface metal raceways and accessory fittings and device boxes.
- C. Submit product data for the following :
  - 1. Flexible metal conduit.
  - 2. Liquidtight flexible metal conduit.
  - 3. Nonmetallic conduit.
  - 4. Flexible nonmetallic conduit.
  - 5. Raceway fittings.
  - 6. Conduit bodies.

7. Surface raceway.
8. Wireway.
9. Pull and junction boxes.
10. Handholes.

## PART 2 PRODUCTS

### 2.01 RIGID METAL CONDUIT AND FITTINGS

- A. Rigid Steel Conduit: ANSI C80.1.
- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; threaded type, material to match conduit.

### 2.02 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

- A. EMT: ANSI C80.3. Galvanized tubing.
- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel or malleable iron, compression type.

### 2.03 FLEXIBLE METAL CONDUIT AND FITTINGS

- A. Conduit: FS WW-C-566; steel.
- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1.

### 2.04 LIQUIDTIGHT FLEXIBLE CONDUIT AND FITTINGS

- A. Conduit: Flexible metal conduit with PVC jacket.
- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1.

### 2.05 NONMETALLIC CONDUIT

- A. Description: NEMA TC 2; Schedule 40 PVC.
- B. Fittings and Conduit Bodies: NEMA TC 3.

### 2.06 CONDUIT SUPPORTS

- A. Conduit Clamps, Straps, and Supports: Steel or malleable iron.

### 2.07 SURFACE METAL RACEWAY

- A. Manufacturers:
  - 1. The Legrand Wiremold Co. Series 2000 metal raceway.
  - 2. Substitutions: Not Permitted.
- B. Product Description: Sheet metal channel with fitted cover, suitable for use as surface metal raceway.
- C. Nominal Size: 1-1/4 x 3/4 inch.
- D. Finish: Buff enamel.
- E. Fittings, Boxes, and Extension Rings: Furnish manufacturer's standard accessories; match finish on raceway.

### 3.01 CONDUIT SIZING, ARRANGEMENT AND SUPPORT

- A. Install conduit in accordance with NECA "Standard of Installation."
- B. Install nonmetallic conduit in accordance with manufacturer's instructions.
- C. Size conduit for conductor type installed or for Type THWN conductors, whichever is larger; 1/2 inch minimum size.
- D. Arrange conduit to maintain headroom and present a neat appearance.
- E. Route exposed conduit and conduit above accessible ceilings parallel and perpendicular to walls and adjacent piping.
- F. Maintain minimum 6 inch clearance between conduit and piping. Maintain 12 inch clearance between conduit and heat sources such as flues, steam pipes, and heating appliances.
- G. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized straps, lay-in adjustable hangers, clevis hangers, or bolted split stamped galvanized hangers.
- H. Group conduit in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps. Provide space for 25 percent additional conduit.
- I. Do not fasten conduit with wire or perforated pipe straps. Remove all wire used for temporary conduit support during construction, before conductors are pulled.
- J. Support conduit at a maximum of 7 feet on center.
- K. Do not use flexible conduit in lengths exceeding six feet.

### 3.02 CONDUIT INSTALLATION

- A. All conduit in finished spaces and normally occupied spaces shall be concealed where ever possible. Where conduit cannot be concealed, use surface metal raceway and manufacturer's standard accessory fittings and device boxes.
- B. Cut conduit square using a saw or pipecutter; de-burr cut ends.
- C. Bring conduit to the shoulder of fittings and couplings and fasten securely.
- D. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
- E. Use conduit hubs or sealing locknuts for fastening conduit to cast boxes, and for fastening conduit to sheet metal boxes in damp or wet locations.
- F.                 Install no more than the equivalent of three 90-degree bends between boxes.
- G. Use conduit bodies to make sharp changes in direction, as around beams.
- H. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2 inch size.
- I. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.
- J. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture.
- K. Provide No. 12 AWG insulated conductor or suitable pull string in empty conduit, except sleeves and nipples.
- L.                 Install expansion joints where conduit crosses building expansion joints.
- M. Where conduit penetrates fire-rated walls and floors, provide mechanical fire-stop fittings with UL listed fire rating equal to wall or floor rating.
- N. Route conduit through roof openings for piping and ductwork where possible; otherwise, route through roof jack with pitch pocket.
- O. Maximum Size Conduit in Slabs Above Grade: 1" inch. Do not route conduits to cross each other in slabs above grade.

- P. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.

### 3.03 CONDUIT INSTALLATION SCHEDULE

- A. Underground Installations For Service Entrance and Building Feeder Conductors: Galvanized rigid steel conduit coated with asphaltum paint after fabrication/installation and prior to backfilling or PVC conduit encased in minimum 3" thickness concrete all around.
- B. Underground Installations and in Concrete Slabs: Schedule 40 PVC nonmetallic conduit. Convert PVC to metallic conduit including any elbows before rising through concrete slabs and continue metallic conduit to electrical enclosures.
- C. Exposed Outdoor Locations: Rigid steel conduit.
- D. Wet Interior Locations: Rigid steel conduit.
- E. Concealed Dry Interior Locations: Inside walls and above ceilings; Electrical metallic tubing.
- F. Exposed Dry Interior Locations: In mechanical and electrical rooms and similar utility spaces; Any conduit meeting NEC requirements. In finished spaces and normally occupied spaces; Surface metal raceway.

### 3.04 PAINTING

- A. All conduit shall be field painted to match the adjacent wall color where walls are painted.
- B. Surface metal raceway shall be manufacturer's standard painted finish.
- C. All conduit containing fire alarm conductors shall be painted red.

END OF SECTION





## SECTION 26 05 33

### BOXES

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Wall and ceiling outlet boxes.
- B. Pull and junction boxes.

##### 1.02 RELATED SECTIONS

- A. Section 26 27 26 - Wiring Devices: Wall plates in finished areas and access floor boxes.

##### 1.03 REFERENCES

- A. NECA - Standard of Installation.
- B. NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.
- C. NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- E. NFPA 70 - National Electrical Code.

##### 1.04 SUBMITTALS FOR REVIEW

- A. Submit shop drawings and product data under the provisions of Section 26 03 05.

##### 1.05 SUBMITTALS FOR CLOSEOUT

- A. Section 01 78 00 - Closeout Submittals: Operation and Maintenance Data submittals for Project closeout.
- B. Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

##### 1.06 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Provide Products listed and classified by Underwriters Laboratories, Inc., as suitable for

the purpose specified and indicated.

## PART 2 PRODUCTS

### 2.01 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
- B. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2 inch (13 mm) male fixture studs where required.
- C. Concrete Ceiling Boxes: Concrete type.
- D. Cast Boxes: NEMA FB 1, Type FD, cast ferrous alloy. Provide gasketed cover by box manufacturer. Provide threaded hubs.
- E. Wall Plates for Finished Areas: As specified in Section 26 27 26.

### 2.02 PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify locations of floor boxes and outlets in offices, and work areas prior to rough-in.

### 3.02 INSTALLATION

- A. Install boxes in accordance with NECA "Standard of Installation."
- B. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.
- C. Set wall mounted boxes at elevations to accommodate mounting heights specified in section for outlet device.
- D. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Adjust box location up to 3 feet if required to accommodate intended purpose.
- E. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.
- F. Maintain headroom and present neat mechanical appearance.
- G. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas

only.

- H. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches (150 mm) from ceiling access panel or from removable recessed luminaire.
- I. Install boxes to preserve fire resistance rating of partitions and other elements.
- J. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- K. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.
- L. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
- M. Use flush mounting outlet box in finished areas.
- N. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- O. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches (150 mm) separation. Provide minimum 24 inches (600 mm) separation in acoustic rated walls.
- P. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- Q. Use stamped steel bridges to fasten flush mounting outlet box between studs.
- R. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- S. Use adjustable steel channel fasteners for hung ceiling outlet box.
- T. Do not fasten boxes to ceiling support wires.
- U. Support boxes independently of conduit.
- V. Use gang box where more than one device is mounted together. Do not use sectional box.
- W. Use gang box with plaster ring for single device outlets.
- X. Use cast outlet box with gasket cover in exterior locations and wet locations.
- Y. Use cast floor boxes for installations in slab on grade; formed steel boxes are

Z. Set floor boxes level.

AA. Large Pull Boxes: Use NEMA 1 hinged enclosure in interior dry locations, and NEMA 3R hinged enclosure in other locations.

### 3.03 ADJUSTING

- A. Adjust floor box flush with finish flooring material.
- B. Adjust flush-mounting outlets to make front flush with finished wall material.
- C. Install knockout closures in unused box openings.

### 3.04 CLEANING

- A. Clean interior of boxes to remove dust, debris, and other material.
- B. Clean exposed surfaces and restore finish.

### 3.05 PAINTING

- A. Paint all junction boxes to match adjacent wall color where walls are painted.
- B. Paint all junction boxes containing fire alarm conductors red.

END OF SECTION

## SECTION 26 05 34

### FLOOR BOXES

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Section includes floor boxes; floor box service fittings; poke-through fittings; and access floor boxes.
- B. Related Sections:
  - 1. Section 07 84 00 - Firestopping.
  - 2. Section 26 05 29 - Supporting Devices.
  - 3. Section 26 05 33 - Raceway and Boxes.
  - 4. Section 26 27 26 - Wiring Devices: Receptacles for installation in floor boxes.

##### 1.02 REFERENCES

- A. National Electrical Manufacturers Association:
  - 1. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

##### 1.03 SUBMITTALS

- A. Section 26 03 05 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit catalog data for floor boxes and service fittings.

##### 1.04 CLOSEOUT SUBMITTALS

- A. Section 26 03 05 - Execution Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of each floor box and poke-through fitting.

##### 1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

#### PART 2 PRODUCTS

##### 2.01 FLOOR BOXES

- A. Floor Boxes shall be of the concealed service type. Provide units with flush, hinged covers that conceal all wiring connections. Covers shall accept carpet or tile inserts.

Exposed trim shall be metal, brushed aluminum or brass in color.

- B. Floor Boxes shall be sized to allow the installation of two (2) duplex, 120 volt convenience receptacles and two (2) duplex, telephone/data communications receptacles.
- C. Material: Cast metal.
- D. Shape: Rectangular.
- E. Service fittings and devices: As specified in Section 26 27 26.
- F. Floor Boxes shall be Walker RFB Series or approved equal.

## 2.02 PEDESTAL-TYPE CONVENIENCE OUTLET SERVICE FITTING

- A. Housing: Satin aluminum.
- B. Device Plate: Stainless steel.
- C. Configuration: One duplex or two duplex, back-to-back as required.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify locations of floor boxes and outlets in all rooms with Architect prior to rough-in.

### 3.02 INSTALLATION

- A. Boxes and fittings are indicated on Drawings in approximate locations unless dimensioned. Scale drawings to determine locations. Adjust box location up to 12 inches to accommodate intended purpose. Verify all adjustments with Architect before placing floor boxes.
- B. Floor Box Requirements: Use cast floor boxes for installations in slab on grade.
- C. Set floor boxes level.
- D. Install boxes and fittings to preserve fire resistance rating of slabs and other elements, using materials and methods specified in Section 26 05 29.
- E. Install protective rings on active flush cover service fittings.

### 3.03 ADJUSTING

- A. Adjust floor box flush with finish flooring material.
- B. Install flooring material in all floor box recessed covers.

#### 3.04 CLEANING

- A. Clean interior of boxes to remove dust, debris, and other material.

END OF SECTION





## SECTION 26 05 53

### ELECTRICAL IDENTIFICATION

#### PART 1 GENERAL

##### 1.01 WORK INCLUDED

- A. Nameplates.
- B. Wire and cable markers.
- C. Conduit color coding.

##### 1.02 SUBMITTALS

- A. Submit shop drawings under provisions of Section 26 03 05. Include schedule for nameplates and tape labels.

#### PART 2 PRODUCTS

##### 2.01 MATERIALS

- A. Nameplates: Engraved three-layer laminated plastic, White letters on a Black background, unless otherwise noted on the drawings.
- B. Wire and Cable Markers: Cloth markers, split sleeve or tubing type.

#### PART 3 EXECUTION

##### 3.01 INSTALLATION

- A. Degrease and clean surfaces to receive nameplates.
- B. Install nameplates parallel to equipment lines.
- C. Secure nameplates to equipment fronts using screws, rivets, or adhesive. Secure nameplate to inside face of recessed panelboard doors in finished locations.
- D. Embossed tape will not be permitted for any application.

##### 3.02 WIRE IDENTIFICATION

- A. Provide wire markers on each feeder conductor in panelboard gutters, pull boxes, and at load connection. Identify with feeder number for power and lighting circuits.

##### 3.03 NAME PLATE ENGRAVING SCHEDULE

- A. Provide nameplates of minimum letter height as scheduled below.
- B. Panelboards and Switchboards: 1/4 inch; identify equipment designation. 1/8 inch; identify voltage rating and source.
- C. Individual Circuit Breakers, Enclosed Switches, and Motor Starters: 1/8 inch; identify load served.

END OF SECTION

## SECTION 26 24 13

### SWITCHBOARDS

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Section includes main and distribution switchboards.
- B. Related Sections:
  - 1. Section 26 05 26 - Grounding and Bonding.
  - 2. Section 26 05 53 - Electrical Identification.
  - 3. Section 33 71 73 - Electrical Utility Services: Utility metering equipment.

##### 1.02 REFERENCES

- A. American National Standards Institute:
  - 1. ANSI C12.1 - Code for Electricity Metering.
  - 2. ANSI C39.1 - Requirements, Electrical Analog Indicating Instruments.
- B. Institute of Electrical and Electronics Engineers:
  - 1. IEEE C57.13 - Standard Requirements for Instrument Transformers.
  - 2. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- C. National Electrical Manufacturers Association:
  - 1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
  - 2. NEMA FU 1 - Low Voltage Cartridge Fuses.
  - 3. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
  - 4. NEMA PB 2 - Deadfront Distribution Switchboards.
  - 5. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less.
- D. International Electrical Testing Association:
  - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

##### 1.03 SUBMITTALS

- A. Section 26 03 05 - Submittal Procedures: Submittal procedures..
- B. Shop Drawings: Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars for each phase, neutral, and ground; and switchboard instrument details.

- C. Product Data: Submit electrical characteristics including voltage, frame size and trip ratings, fault current withstand ratings, and time-current curves of equipment and components.
- D. Test Reports: Indicate results of factory production and field tests.

#### 1.04 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations, configurations, and ratings of switchboards and their components on single line diagrams and plan layouts.
- C. Operation and Maintenance Data: Submit spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

#### 1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver in 48 inch maximum width shipping splits, individually wrapped for protection and mounted on shipping skids.
- B. Accept switchboards on site. Inspect for damage.
- C. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.
- D. Handle in accordance with NEMA PB 2.1. Lift only with lugs provided. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

#### 1.07 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.
- B. Conform to NEMA PB 2 service conditions during and after installation of switchboards.

#### 1.08 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

#### 1.09 SEQUENCING

- A. Section 01 10 00 - Summary: Work sequence.
- B. Sequence Work to avoid interferences with building finishes and installation of other products.

#### 1.10 MAINTENANCE MATERIALS

- A. Section 01 70 00 - Execution Requirements: Spare parts and maintenance products.
- B. Furnish two of each key.

### PART 2 PRODUCTS

#### 2.01 SERVICE DISTRIBUTION SWITCHBOARDS

- A. Product Description: NEMA PB 2, enclosed switchboard with electrical ratings and configurations as indicated on Drawings. Service entrance rated.
- B. Ratings:
  - 1. Voltage: 120/208 volts.
  - 2. Configuration: Three phase, four wire, grounded.
  - 3. Minimum Size: Switchboard construction shall be used for all panels 1000 amperes and larger.
  - 4. Main Bus: Size switchboards and indicated on schedules on plans.
  - 5. Integrated Equipment Rating: 65,000 rms amperes symmetrical. Brand and feeder devices may be series rated with main device.
- C. Device Mounting:
  - 1. Main Section: Individually mounted.
  - 2. Distribution Section: Panel mounted.
- D. Bus:
  - 1. Material: Copper with tin plating, standard size.
  - 2. Connections: Bolted, accessible from front for maintenance.
  - 3. Insulation: Fully insulate bus bars. Do not reduce spacing of insulated bus.
- E. Ground Bus: Extend length of switchboard.
- F. Line and Load Terminations: Accessible from front only of switchboard, suitable for conductor materials and sizes as indicated on Drawings.
- G. Future Provisions: Fully equip spaces for future devices with bussing and bus connections, insulated and braced for short circuit currents. Furnish continuous current rating.
- H. Enclosure: NEMA Type 12.

- I. Align sections at front and rear.
- J. Switchboard Height: 90 inches, excluding floor sills, lifting members and pull boxes.
- K. Finish: Manufacturer's standard light gray enamel over external surfaces. Coat internal surfaces with minimum one coat corrosion-resisting paint, or plate with cadmium or zinc.

## 2.02 MOLDED CASE CIRCUIT BREAKER

- A. Product Description: NEMA AB 1, molded-case circuit breaker.
- B. Field-Adjustable Trip Circuit Breaker: Circuit breakers with frame sizes 200 amperes and larger shall have mechanism for adjusting long time, short time, continuous current, short time, long time, pickup current setting for automatic operation.
- C. Solid-State Circuit Breaker: Electronic sensing, timing, and tripping circuits for adjustable current settings; instantaneous trip; and adjustable short time trip.
- D. Accessories: As indicated on Drawings. Conform to NEMA AB 1.
  - 1. Shunt Trip Device: 120 volts, AC.
  - 2. Handle Lock: Provisions for padlocking.
  - 3. Grounding Lug: In each enclosure.

## 2.03 INSULATED CASE CIRCUIT BREAKER

- A. Product Description: NEMA AB 1, enclosed, insulated-case circuit breaker.
- B. Trip Unit: Electronic sensing, timing, and tripping circuits for adjustable current settings; instantaneous trip; and adjustable short time trip.
- C. Accessories: As indicated on Drawings. Conform to NEMA AB 1.
  - 1. Shunt Trip Device: 120 volts, AC.
  - 2. Handle Lock: Provisions for padlocking.
  - 3. Grounding Lug: In each enclosure.

## 2.04 GROUND FAULT DEVICES

- A. Ground Fault Sensor: Zero sequence type.
- B. Ground Fault Relay: Adjustable ground fault sensitivity from 200 to 1200 amperes, time delay adjustable from 0 to 15 seconds. Furnish monitor panel with lamp to indicate relay operation, TEST and RESET control switches.

## 2.05 AMMETERS AND VOLTMETERS

A. Provide electronic microprocessor-based equipment capable of displaying amps and volts for all phases, peak demand, present demand and energy consumption unit shall be Westinghouse IQ Data Plus II or approved equal.

## 2.06 METERING TRANSFORMERS

A. Current Transformers: IEEE C57.13; 5 ampere secondary, bar or window type, with single secondary winding and secondary shorting device, primary/secondary ratio as recommended by manufacturer, burden and accuracy consistent with connected metering and relay devices, 60 Hertz.

B. Potential Transformers: IEEE C57.13; 120 volt single secondary, disconnecting type with integral fuse mountings, primary/secondary ratio as recommended by manufacturer, burden and accuracy consistent with connected metering and relay devices, 60 Hertz.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify surface is suitable for switchboard installation.

### 3.02 INSTALLATION

A. Install in accordance with NEMA PB 2.1.

B. Tighten accessible bus connections and mechanical fasteners after placing switchboard.

C. Install fuses in each switch and coordinate sizes with connected load.

D. Install engraved plastic nameplates in accordance with Section 26 05 53.

E. Install breaker circuit directory.

F. Ground and bond switchboards in accordance with Section 26 05 26.

### 3.03 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.1.

### 3.04 ADJUSTING

- A. Section 01 70 00 - Execution Requirements: Testing, adjusting, and balancing.
- B. Adjust operating mechanisms for free mechanical movement.
- C. Tighten bolted bus connections.
- D. Adjust circuit breaker trip and time delay settings to values as indicated on Drawings.

### 3.05 CLEANING

- A. Section 01 70 00 - Execution Requirements: Final cleaning.
- B. Touch up scratched or marred surfaces to match original finish.

END OF SECTION



## SECTION 26 24 16

### PANELBOARDS

#### PART 1 GENERAL

##### 1.01 WORK INCLUDED

- A. Distribution panelboards.
- B. Lighting and appliance branch circuit panelboards.

##### 1.02 REFERENCES

- A. NEMA AB 1 - Molded Case Circuit Breakers.
- B. NEMA PB 1 - Panelboards.
- C. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- D. NEMA PB 1.2 - Application Guide for Ground-fault Protective Devices for Equipment.

##### 1.03 SUBMITTALS

- A. Submit shop drawings and product data for equipment and component devices under provisions of Section 26 03 05.
- B. Include outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

##### 1.04 SPARE PARTS

- A. Keys: Furnish 2 each to Owner, for each cabinet lock installed.

#### PART 2 PRODUCTS

##### 2.01 MAIN DISTRIBUTION PANELBOARDS AND PANELBOARDS FOR AIR CONDITIONING EQUIPMENT:

- A. Panelboards: NEMA PB 1; circuit breaker type.
- B. Enclosure: NEMA PB 1; Type 1. Cabinet size: 6 inches deep; 20 inches wide and NEMA type 3R for outdoor installation.

- C. Provide cabinet front with hinged interior cover and hinged door with flush lock. Finish in manufacturer's standard gray enamel.
- D. Provide panelboards with copper bus, ratings as scheduled on Drawings. Provide copper ground bus in all panel boards.
- E. Maximum panelboard ampacity shall be 800 amperes. Switchboard construction shall be used for equipment 1000 amperes and larger.
- F. Minimum Integrated Short Circuit Rating: 22,000 amperes rms symmetrical for 208 volt. Select panelboards rated to meet maximum rms amperes symmetrical as required by the utility company service requirements.
- G. Molded Case Circuit Breakers: NEMA AB 1 provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.

## 2.02 BRANCH CIRCUIT PANELBOARDS

- A. Lighting and Branch Circuit Panelboards: NEMA PB1; circuit breaker type.
- B. Enclosure: NEMA PB 1; Type 1 indoor, NEMA 3R outdoor.
- C. Cabinet Size: 6 inches deep; 20 inches wide.
- D. Provide flush or surface as cabinet front as indicated with hinged interior cover concealed trim clamps, concealed hinge and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.
- E. Provide panelboards with copper bus, ratings as scheduled on Drawings. Provide copper ground bus in all panelboards.
- F. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical for 208 volt panelboards.
- G. Molded Case Circuit Breakers: NEMA AB 1; bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers for circuits indicated on Drawings.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install panelboards plumb and flush with wall finishes, in conformance with NEMA PB 1.1.

- B. Height: 6 ft.
- C. Provide filler plates for unused spaces in panelboards.
- D. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.
- E. Stub 5 empty one inch conduits to accessible location above ceiling out of each recessed panelboard.

### 3.02 FIELD QUALITY CONTROL

- A. Measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 20 percent, rearrange circuits in the panelboard to balance the phase loads within 20 percent. Take care to maintain proper phasing for multi-wire branch circuits.
- B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

### 3.03 PANELBOARD SCHEDULE

- A. Panelboards shall be as scheduled on the Drawings.

### 3.04 SURGE SUPPRESSION

- A. Provide transient voltage surge suppression protection according to Section 26 35 55, "Transient Voltage Surge Suppression" on all new panelboards.

END OF SECTION

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## SECTION 26 24 18

### MOTOR CONTROL

#### PART 1 GENERAL

##### 1.01 WORK INCLUDED

- A. Manual motor starters.
- B. Magnetic motor starters.
- C. Combination magnetic motor starters.

##### 1.02 REFERENCES

- A. ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
- B. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service.
- C. FS W-P-115 - Power Distribution Panel.
- D. FS W-S-865 - Switch, Box, (Enclosed), Surface-Mounted.
- E. NEMA AB 1 - Molded Case Circuit Breakers.
- F. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.
- G. NEMA KS 1 - Enclosed Switches.
- H. NEMA PB 1 - Panelboards.
- I. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

##### 1.03 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 26 03 05.
- B. Provide product data on motor starters and combination motor starters, relays, pilot devices, and switching and overcurrent protective devices.
- C. Submit manufacturers' instructions under provisions of Section 26 03 05-1.09.

##### 1.04 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 26 03 05-1.05.
- B. Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Section 26 03 05-1.07.
- B. Store and protect products under provisions of Section 26 03 05-1.07.

#### 1.06 SPARE PARTS

- A. Keys: Furnish 2 each to Owner, for each cabinet lock installed.

### PART 2 PRODUCTS

#### 2.01 MANUAL MOTOR STARTERS

- A. Manual Motor Starter: NEMA ICS 2; size M-0 3 pole, AC general-purpose Class A manually operated non-reversing full-voltage controller for induction motors rated in horsepower, with overload relay, NO auxiliary contact, and push button operator.
- B. Fractional Horsepower Manual Starter: NEMA ICS 2; AC general-purpose Class A manually operated, 2 pole, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, and toggle operator.
- C. Motor Starting Switch: NEMA ICS 2; AC general-purpose Class A manually operated 2 pole, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, toggle operator.
- D. Enclosure: ANSI/NEMA ICS 6; Type 1, unless indicated otherwise.

#### 2.02 MAGNETIC MOTOR STARTERS

- A. Magnetic Motor Starters: NEMA ICS 2; AC general-purpose Class A magnetic controller for induction motors rated in horsepower.
- B. Full Voltage Starting: Non-reversing type.
- C. Coil Operating Voltage: 120 volts, 60 Hertz.
- D. Size: NEMA ICS 2; size as shown on Drawings.
- E. Overload Protection Device: NEMA ICS 2; melting alloy thermal . Electronic overload

relays are not acceptable.

- F. Enclosure: NEMA ICS 6; Type 1. Unless indicated otherwise.
- G. Combination Motor Starters: Combine motor starters with motor circuit protector disconnect in common enclosure.
- H. Auxiliary Contacts: NEMA ICS 2; two and field convertible contacts in addition to seal-in contact.
- I. Pushbuttons: NEMA ICS 2; START/STOP in front cover.
- J. Indicating Lights: NEMA ICS 2; RUN: green in front cover.
- K. Selector Switches: NEMA ICS 2; HAND/OFF/AUTO in front cover.
- L. Control Power Transformers: 120 volt secondary, capacity as required for control equipment.
- M. Transient Voltage Surge Suppressor: Manufacturer's standard coil transient suppressor, factory installed.
- N. Manufacturer: Magnetic motor starters shall be Square D, no substitutions.

## 2.03 CONTROLLER OVERCURRENT PROTECTION AND DISCONNECTING MEANS

- A. Motor Circuit Protector: NEMA AB 1; circuit breakers with integral instantaneous magnetic trip in each pole.
- B. Provide manufacturer's standard transient voltage surge suppressor, factory installed.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install motor control equipment in accordance with manufacturer's instructions.
- B. Select and install heater elements in motor starters to match installed motor characteristics.
- C. Motor Data: Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

END OF SECTION

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## SECTION 26 27 16

### CABINETS AND ENCLOSURES

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Hinged cover enclosures.
- B. Cabinets.
- C. Terminal blocks.
- D. Accessories.

##### 1.02 RELATED SECTIONS

- A. Section 26 05 29 - Supporting Devices.

##### 1.03 REFERENCES

- A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- B. NEMA ICS 4 - Terminal Blocks for Industrial Control Equipment and Systems.
- C. ANSI/NFPA 70 - National Electrical Code.

##### 1.04 SUBMITTALS

- A. Submit under provisions of Section 26 03 05.
- B. Product Data: Provide manufacturer's standard data for enclosures and cabinets.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

##### 1.05 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

## 1.06 EXTRA MATERIALS

- A. Provide two of each cabinet key.

## PART 2 PRODUCTS

### 2.01 HINGED COVER ENCLOSURES

- A. Construction: NEMA 250, Type 12 steel enclosure.
- B. Covers: Continuous hinge, held closed by flush latch operable by key.
- C. Provide interior metal panel for mounting terminal blocks and electrical components; finish with white enamel.
- D. Enclosure Finish: White enamel. Stainless steel in manufacturing areas and laboratories.

### 2.02 CABINETS

- A. Boxes: Galvanized steel.
- B. Backboard: Provide interior metal panel for mounting terminals blocks and electrical components; finish with white enamel.
- C. Fronts: Steel, flush type with concealed trim clamps, concealed hinge, and flush lock keyed to match branch circuit panelboard. Finish with gray baked enamel.
- D. Provide metal barriers to separate compartments containing control wiring operating at less than 50 volts from power wiring.
- E. Provide accessory feet for free-standing equipment.

### 2.03 TERMINAL BLOCKS

- A. Terminal Blocks: ANSI/NEMA ICS 4.
- B. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.
- C. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.
- D. Provide ground bus terminal block, with each connector bonded to enclosure.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install Products in accordance with manufacturer's instructions.
- B. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner.
- C. Install cabinet fronts plumb.

END OF SECTION



## SECTION 26 27 26

### WIRING DEVICES

#### PART 1 GENERAL

##### 1.01 WORK INCLUDED

- A. Wall switches.
- B. Receptacles.
- C. Floor mounted service fittings.
- D. Device plates and box covers.

##### 1.02 REFERENCES

- A. NEMA WD 1 - General-Purpose Wiring Devices.
- B. NEMA WD 5 - Specific-Purpose Wiring Devices.

##### 1.03 SUBMITTALS

- A. Submit product data under provisions of Section 26 03 05.
- B. Provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.

#### PART 2 PRODUCTS

##### 2.01 WALL SWITCHES

- A. Wall Switches for Lighting Circuits: NEMA WD 1. AC general use snap switch with toggle handle, rated 20 amperes at 277 volts AC. Handle: Ivory plastic.
- B. Pilot Light Type: Pilot strap in adjacent gang.

##### 2.02 RECEPTACLES

- A. Convenience and Straight-blade Receptacles: NEMA WD 1.
- B. Locking-Blade Receptacles: NEMA WD 5.
- C. Convenience Receptacle Configuration: NEMA WD 1; Type 5- 20 R.

- D. Specific-use Receptacle Configuration: NEMA WD 1 or WD 5; type as indicated on Drawings.
- E. GFCI Receptacles: Duplex convenience receptacle with integral ground fault current interrupter.

## 2.03 WALL PLATES

- A. Decorative Cover Plate: Brushed stainless steel, jumbo size for all finished room locations.
- B. Device Plates for Surface Mounted Outlets: Galvanized surface outlet covers to fit 4 inch square boxes in unfinished utility rooms.
- C. Weatherproof Cover Plate: Gasketed cast metal with hinged gasketed device covers.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install wall switches 48 inches above floor, OFF position down.
- B. Install convenience receptacles 18 inches above floor, 6 inches above counters or backsplash if present, grounding pole on bottom.
- C. Install specific-use receptacles at heights shown on Contract Drawings.
- D. Corridor Convenience Receptacles: Hospital Grade.
- E. Install smooth stainless steel plates on switch, receptacle, and blank outlets in finished areas, using jumbo size plates for outlets installed in all walls.
- F. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface-mounted outlets.
- G. Install devices and wall plates flush and level.

END OF SECTION

SECTION 26 28 19

DISCONNECT SWITCHES

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Disconnect switches.
- B. Enclosures.

1.02 REFERENCES

- A. NEMA KS 1 - Enclosed Switches.

1.03 SUBMITTALS

- A. Submit product data under provisions of Section 26 03 05.

PART 2 PRODUCTS

2.01 DISCONNECT SWITCHES

- A. Fused or Nonfusible Switch Assemblies: NEMA KS 1; Type HD; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.
- B. Enclosures: NEMA KS 1; Type as indicated on Drawings.
- C. Fuse Rating/Size: As shown on Drawings.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install disconnect switches where indicated on Drawings or as required in Division 23.

END OF SECTION

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## SECTION 26 28 23

### ENCLOSED CIRCUIT BREAKERS

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Section includes molded-case and insulated-case circuit breakers in individual enclosures.

##### 1.02 REFERENCES

- A. National Electrical Manufacturers Association:
  - 1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
- B. International Electrical Testing Association:
  - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

##### 1.03 SUBMITTALS

- A. Section 26 03 05 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit catalog sheets showing ratings, trip units, time current curves, dimensions, and enclosure details.

##### 1.04 CLOSEOUT SUBMITTALS

- A. Section 26 03 05 - Execution Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations and continuous current ratings of enclosed circuit breakers.

##### 1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

#### PART 2 PRODUCTS

##### 2.01 MOLDED CASE CIRCUIT BREAKER

- A. Product Description: Enclosed, molded-case circuit breaker conforming to NEMA AB 1, suitable for use as service entrance equipment where applied.

- B. Accessories: Conform to NEMA AB 1.
  - 1. Handle Lock: With provisions for padlocking.
  - 2. Grounding Lug: In each enclosure.
- C. Enclosure: NEMA AB 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
  - 1. Interior Dry Locations: Type 1.
  - 2. Exterior Locations: Type 3R.
- D. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.
- E. Minimum integrated short circuit rating: 22,000 amperes rms symmetrical for 208 volt breakers; 25,000 amperes rms symmetrical for 480 volt breakers.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install enclosed circuit breakers plumb. Provide supports in accordance with Section 26 05 29.
- B. Height: 5 feet to operating handle.
- C. Locate and install engraved plastic nameplates in accordance with Section 26 05 53.

### 3.02 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.6.1.1.

END OF SECTION

## SECTION 26 29 23

### VARIABLE FREQUENCY AC DRIVES

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. This section provides specification requirements for AC inverter type adjustable frequency variable speed drives or herein identified as AC drives for use with NEMA B design, AC motors.
- B. The contractor shall furnish, test, install and place in satisfactory operation all AC drives, with spare parts as specified.
- C. Any exceptions to this specification shall be indicated in writing and submitted with the quotation.
- D. The manufacturer shall have a nationwide field service and technical support organization available 24 hours a day from an 800 telephone number. Capabilities shall include factory coordinated start-up service and on-site training of customer personnel.

##### 1.02 SUBMITTALS

- A. Complete wiring diagrams and chassis outline drawings shall be furnished for review and approval before assembly of the AC drives shall commence. Drawings shall include front and side views with overall dimensions and weights shown.
- B. Two each standard operation and maintenance instruction manuals shall be furnished for each horsepower size of AC drive.
- C. Standard catalog sheets showing voltage, horsepower and current ratings; dimensions and enclosure details shall be furnished for each AC drive provided.
- D. A detailed list of replacement circuit cards, fuses and power components shall be provided with part numbers and pricing information for each drive horsepower size.

##### 1.03 MANUFACTURERS' EXPERIENCE

- A. The manufacturer shall have been specialized in the production of this type of equipment for a period of at least 10 years.

- B. The AC drive(s) and other electrical gear herein specified, shall be supplied and manufactured by the AC drive manufacturer who shall coordinate and verify their operation.
- C. For the equipment specified herein, the manufacturer shall be ISO 9001 certified
- D. Substitute products that are in compliance with the specification and manufactured by others will be considered as “Approved Equal” only if pre-approved by the Engineer fourteen (14) days prior to bid date. Alternate suppliers shall submit documentation showing itemized compliance to the specifications and experience specific to the proposed AC drive including a list showing details of the installation, application, location, contact name and telephone number of at least 10 users.

#### 1.04 QUALITY ASSURANCE

- A. Every AC drive unit shall be designed, constructed and tested in accordance with NEMA, UL, NEC and IEEE recommendations.
- B. Every AC drive and all supplied options shall be UL approved and listed according to UL 50. The controller shall have a UL listed label attached inside the enclosure as verification.
- C. Every AC drive shall be tested with an actual motor load and temperature cycled within an environmental chamber at 104EF (40EC). The frequency output and voltage will be varied throughout the test. Documentation shall be furnished to verify successful completion at the request of the specifier.

#### 1.05 WARRANTY

- A. A one-year warranty shall be provided on materials and workmanship from date of substantial completion.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. The AC drives supplied shall be Yaskawa, ABB, Danfoss/Trane or approved equal.
- B. Alternate adjustable frequency control drive techniques other than pulse width modulated (PWM) technology will not be considered.

#### 2.02 GENERAL DESCRIPTION

- A. The AC drive shall convert the input AC mains power to an adjustable frequency and voltage. The output frequency and voltage of the AC drive shall be adjustable to maintain a constant V/Hz ratio throughout the operating range. The AC drive shall be designed to operate from 480v three phase, 60 Hz main supply that is within +10% , -10% of nominal line voltage.
- B. The rectifier stage shall convert fixed voltage, fixed frequency, ac line power to fixed dc voltage. The input power section shall utilize a full wave bridge design incorporating diode rectifiers. Designs that incorporate silicon controlled rectifiers (SCRs) will not be allowed. The dc bus voltage shall be filtered. The rectifier shall be insensitive to the phase rotation of the AC line and shall not cause a displacement power factor of less than .95 lagging under any speed or load condition.
- C. The inverter shall change fixed dc voltage to variable frequency AC for application to a standard NEMA B motor. The inverter section shall utilize Gate Turn-Off Thyristor power devices or transistors as required by the current rating of the motor. Paralleling of inverter power devices to increase current rating is not acceptable.
- D. The AC drive shall be capable of operating into an open circuit without damage in order to facilitate start-up/maintenance.

## 2 .03 INPUT CONTROLS AND SIGNALS

- A. The drive shall be capable of accepting the following inputs.
  1. 0-10 vdc speed control analog signal
  2. 4-20 ma speed control analog signal
  3. Forward run digital signal 24 vdc
  4. Three minute programmable digital speed inputs 0-100%, 24 vdc
  5. Logic input and output for interface with programmable logic controller

## 2 .04 OUTPUT CONTROLS AND SIGNALS

- A. The drive shall be capable of the following outputs.
  1. Relay contact for "POWER ON"
  2. Relay contact for "FAULT"
  3. 24 vdc 100ma minimum power source for digital input convenience

## 2 .05 MOTOR DATA

- A. The AC drive shall be designed to operate NEMA B electrical pump motors with a nameplate rating of 480v, three phase power, 1 through 2000 horsepower, Variable Torque (VT) and a 1.15 service factor.

## 2.06 RATINGS

- A. The AC drive shall be capable of supplying 120% of rated full load current for one minute at maximum ambient temperature.
- B. The AC drive unit and not just the fuses shall be rated for installation in a power system capable of delivering up to 65,000 RMS symmetrical amperes.
- C. The AC drive shall be capable of operating within -10% to +10% of nominal voltage rating
- D. The minimum displacement power factor shall be .95 throughout the entire speed range.
- E. The AC drive shall be capable of operating without damage with the motor disconnected.
- F. The AC drive efficiency shall be 98% at full speed.
- G. Storage temperature range shall be -4EF to 176EF (-20EC to +80EC).
- H. The AC drive shall be designed to operate in an ambient temperature of 32EF to 104EF (0EC to 40EC). For locations with temperatures greater than 104EF (40EC), the AC drive will be derated according to the manufacturers test information.
- I. Maximum relative humidity shall be 95%, non-condensing.

## 2.07 ADJUSTMENTS

- A. The acceleration and deceleration ramp rates shall be adjustable from 1 to 60 seconds.
- B. The overload trip shall be adjustable from 0 - 100% of rated output current.
- C. The current limit shall be adjustable from 60 - 120% of rated output current to maximize starting torque.
- D. The voltage boost shall be adjustable from 100 to 400% of nominal V/Hz ratio at 1 Hz tapering to 100% at 20 Hz.
- E. The AC drive shall be capable of providing a control for adjusting the minimum frequency setting up to 45 Hz and a maximum operating frequency adjustable over a range of 40 to 60 Hz.

## 2.08 PROTECTION

- A. A Non-adjustable instantaneous overcurrent trip shall be set to 250% of rated output current.
- B. Protection of the drive shall be accomplished without the use of fast acting semiconductor output fuses. Subjecting the controller to any of the following conditions shall activate fuseless electronic protective circuits and eliminate component failure or the need for fuse replacement:
  - C. Short circuit at AC drive output
  - D. Ground fault at AC drive output
  - E. Open circuit at AC drive output
  - F. Input undervoltage
  - G. DC bus overvoltage
  - H. Loss of input phase
  - I. AC line switching transients
  - J. Instantaneous overload
  - K. Sustained overload exceeding 100% of controller rated current
  - L. Overtemperature

## 2 .09 CONTROL OPTIONS

- A. All operator control options shall be mounted to the front panel which is integral to the AC drive.
- B. Start-stop push button.
- C. Manual speed potentiometer.
- D. Hand-Automatic selector switch. The controller shall accept an input signal of 0-10 vdc as an automatic speed reference signal when the controller is in the automatic mode of operation. The manual speed potentiometer will control the AC drive frequency when the switch is in manual mode.

## 2 .10 OPERATION FEATURES

- A. The AC drive shall be factory set for manual reset after the first protective circuit trip for a malfunction (overcurrent, undervoltage, overvoltage or overtemperature) or an interruption of power. Automatic restart with two fault lockout shall provide a reset to allow the controller to restart automatically when configured in two wire start/stop control. Three wire control will require a manual restart signal; however, the number of restarts before lockout still applies if the AC drive is set for 2 fault lockout. The AC drive shall attempt to restart after a selected time delay. If the drive faults again within 33 seconds, a manual restart will be required.
- B. The number of allowed faults before the drive is disabled from automatically starting shall be programmable from 1 to 2.
- C. The AC drive shall be capable of restarting into a motor coasting in either forward or reverse direction without component failure or tripping off line.
- D. The AC drive shall include static reversing which shall change the output phase rotation to reverse the motor rotation.
- E. The AC drive shall include external fault reset capability. All the necessary logic to accept an external fault reset contact shall be included.

## 2.11 OPERATOR INTERFACE

- A. A Front panel mounted alphanumeric display with a keypad shall be provided to allow the operator access to drive modes, parameters and status conditions. Data will be edited via the keypad. Memory will consist of a main and a non-volatile, back-up memory. The back-up table is used to restore previous mode values without editing each mode individually.
- B. Pilot devices such as push buttons, selector switches and relay contacts shall be supported as an alternative method of control operation.
- C. Access to edit modes shall be restricted. There will be a fault reset that will not enable the AC drive to start unless the fault condition is corrected. Operator control and set-up functions will include the following:
  1. Frequency setpoint
  2. Acceleration/Deceleration Time
  3. Minimum/Maximum Output Frequencies
  4. Proportional Gain
  5. Integral Gain
  6. Set point
  7. Drive Reset
  8. Elapsed Time
  9. Enable PI (Set point) Control
  10. Auto Reference Source Select



11. Operating status information will consist of the following:
  12. Frequency Output
  13. Output Current
  14. Output Voltage
  15. Axle/Decel Ramp Time
  16. Forward/Reverse Direction
  17. Hand/Auto Local Indicator
  18. Elapsed Time
- D. The diagnostic and fault conditions available via the operator interface will include the following:
1. Output Frequency
  2. Output Current
  3. Output Voltage
  4. Shutdown Reference Status
  5. Jog Status
  6. Mode of Operation
  7. Input Signal Levels
  8. Faults
  9. Overload Timer Activated
  10. Motor Current Limit

## 2.12 CONTROL REQUIREMENTS

### A. Control Functions

1. Frequently accessed AC drive programmable parameters shall be adjustable from a digital operator keypad located on the front of the AC drive. The AC drive shall have a 3 line alphanumeric programmable display with status indicators. Keypads must use plain English words for parameters, status, and diagnostic messages. Keypads that are difficult to read or understand are not acceptable, and particularly those that use alphanumeric code and tables. Keypads shall be adjustable for contrast with large characters easily visible in normal ambient light.
2. The keypad shall include a Local/Remote pushbutton selection. Both start/ stop source and speed reference shall be independently programmable for Keypad, Remote I/O, or Field Bus.
3. The keypad shall have copy / paste capability.
4. Upon initial power up of the AC drive, the keypad shall display a start up guide that will sequence all the necessary parameter adjustments for general start up.
5. Standard advanced programming and trouble-shooting functions shall be available by using a personal computer's RS-232 port and Windows™

based software. In addition the software shall permit control and monitoring via the AC drive RS232 port. The manufacturer shall supply a diskette with the required software. An easily understood instruction manual and software help screens shall also be provided. The computer software shall be used for modifying the drive setup and reviewing diagnostic and trend information as outlined in this section through section 18. Provide one copy of the advanced programming software.

6. The operator shall be able to scroll through the keypad menu to choose between the following:
  - a. Monitor
  - b. Operate
  - c. Parameter setup
  - d. Actual parameter values
  - e. Active faults
  - f. Fault history
  - g. LCD contrast adjustment
  - h. Information to indicate the standard software and optional features software loaded.
  
7. The following setups and adjustments, at a minimum, are to be available:
  - a. Start command from keypad, remote or communications port
  - b. Speed command from keypad, remote or communications port
  - c. Motor direction selection
  - d. Maximum and minimum speed limits
  - e. Acceleration and deceleration times, two settable ranges
  - f. Critical (skip) frequency avoidance
  - g. Torque limit
  - h. Multiple attempt restart function
  - i. Multiple preset speeds adjustment
  - j. Catch a spinning motor start or normal start selection
  - k. Programmable analog output
  - l. DC brake current magnitude and time
  - m. PID process controller
  
8. The AC drive shall have the following system interfaces:
  - a. Inputs – A minimum of six (6) programmable digital inputs, two (2) analog inputs and serial communications interface shall be provided with the following available as a minimum:
    - (1) Remote manual/auto
    - (2) Remote start/stop
    - (3) Remote forward/reverse
    - (4) Remote preset speeds
    - (5) Remote external trip
    - (6) Remote fault reset
    - (7) Process control speed reference interface, 4-20mA DC

- (8) Potentiometer and 1-10VDC speed reference interface
- (9) RS-232 programming and operation interface port
- (10) Serial communications port

## 2.13 Communications

- A. The drive shall be equipped with Embedded BACnet communications (BTL Certified), along with Modbus/Memobus, Metasys and Apogee FLN.

## 2.14 Outputs

- A. A minimum of two (2) discrete programmable digital outputs, one (1) programmable open collector output, and one (1) programmable analog output shall be provided, with the following available at minimum:
  1. Programmable relay outputs with one (1) set of Form C contacts for each, selectable with the following available at minimum:
    2. Fault
    3. Run
    4. Ready
    5. Reversed
    6. Jogging
    7. At speed
    8. Torque Limit Supervision
    9. Motor rotation direction opposite of commanded
    10. Over-temperature
- B. Programmable open collector output with available 24VDC power supply and selectable with the following available at minimum:
  1. Fault
  2. Run
  3. Ready
  4. Reversed
  5. Jogging
  6. At speed
  7. Torque Limit Supervision
  8. Motor rotation direction opposite of commanded
  9. Over-temperature
- C. Programmable analog output signal, selectable with the following available at minimum:
  1. Motor current
  2. Output frequency
  3. Frequency reference
  4. Motor speed
  5. Motor torque
  6. Motor power
  7. Motor voltage

8. DC-bus voltage
9. AI1 (Analog Input 1)
10. AI2 (Analog Input 2)
11. PT100 temperature
12. FB digital input 4 (Field Bus Input)

## 2 .15 Load Reactor

- A. Line reactor: Input line reactor shall be 1.5 to 3% impedance and rated to coordinate with the drive.
- B. Reactor shall be model # KDR by Trans-Coil Inc., 7878 North 86<sup>th</sup> St., Milwaukee, WI. 53224, (800)824-8282, ([www.transcoil.com](http://www.transcoil.com)) or approved equal.

## 2 .16 ENCLOSURE

- A. The AC drive shall be available in NEMA 1 construction for installation in a separate NEMA rated enclosure. This configuration shall be a factory standard offering, and shall allow mounting of the AC drive(s) in approved electrical enclosures.
- B. For exterior installations, the AC drive shall be rated NEMA 1 and installed in in a fan-vented NEMA 3R enclosure with disconnect and hand-off-auto switch. Enclosure shall be Hoffman WF10LP series with heater and transformer or equal. Construct galvanized steel channel rack with minimum (2) 3/4" x 3/4" channel posts imbedded in 18" diameter x 30" deep concrete foundation and (2) 3/4" x 3/4" cross members.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Provide ac drives as indicated on drawings.
- B. Provide line side load reactors.
- C. Install in accordance with NEMA ICS 7.1.
- D. Tighten accessible connections and mechanical fasteners after placing controller.
- E. Install fuses in fusible switches.
- F. Select and install overload heater elements in motor controllers to match installed motor characteristics.

- G. Install engraved plastic nameplates in accordance with Section 26 05 53.
- H. Neatly type label inside controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place label in clear plastic holder.
- I. Ground and bond controller in accordance with Section 26 05 26.

### 3.02 FACTORY TESTS

- A. Each AC drive unit shall be completely functionally tested under actual motor load. Motor speeds will be varied by computer control throughout the test.
- B. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of UL and NEMA standards.
  - 1. All printed circuit boards shall be functionally tested via automatic test equipment prior to unit installation.
  - 2. After all tests have been performed, each AC DRIVE shall undergo a burn-in test. The drive shall be burned in at 100% inductive or motor load without an unscheduled shutdown.
  - 3. After the burn-in cycle is complete, each AC DRIVE shall be put through a motor load test before inspection and shipping.
  - 4. The manufacturer shall provide three (3) certified copies of factory test reports.
- C. The test shall be in a 40E Centigrade temperature controlled environment.
- D. Inspect and test in accordance with NETA ATS, except Section 4.
- E. Perform inspections and tests listed in NETA ATS, Section 7.16 and NEMA ICS 7.1.

### 3.03 FIELD QUALITY CONTROL

- A. Provide the services of a qualified manufacturer's employed Field Service Engineer to assist the Contractor in installation and start-up of the equipment specified under this section. Field Service personnel shall be factory trained with periodic updates and have experience with the same model of AC DRIVE on the job site. Sales representatives will not be acceptable to perform this work. The manufacturer's service representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, installation as specified in manufacturer's installation instructions, wiring, application dependant adjustments, and verification of proper AC DRIVE operation.

- B. The Contractor under the technical direction of the manufacturer's service representative shall perform the following minimum work.
1. Inspection and final adjustments.
  2. Operational and functional checks of AC drives.

END OF SECTION

## SECTION 26 35 55

### TRANSIENT VOLTAGE SURGE SUPPRESSION

#### PART 1 - GENERAL

##### 1.01 DESCRIPTION

- A. This section describes the materials and installation requirements for transient voltage surge suppressors (TVSS) for the protection of all AC electrical circuits from the effects of lightning induced currents, substation switching transients and internally generated transients resulting from inductive and/or capacitive load switching.
- B. This section includes materials and installation of Transient Voltage Surge Suppressors (TVSS) for the protection of electronic circuits and equipment.

##### 1.02 RELATED WORK

- A. Section 260305, "General Electrical Requirements"
- B. Section 260532, "Conduit"
- C. Section 260519, "Wire and Cable"
- D. Section 260533, "Boxes"
- E. Section 260526, "Secondary Grounding"
- F. Section 262418, "Motor control"

##### 1.03 REFERENCES

- A. UL 1449 Second Edition, 2005 Revision (effective 2/9/2007).
- B. UL 1283.
- C. ANSI/IEEE C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- D. ANSI/IEEE C62.45, Guide for Surge Testing for equipment connected to Low-Voltage AC Power Circuits.
- E. IEEE 1100 Emerald Book.
- F. NEMA LS-1, 1992-(R2000) Low-Voltage Surge Protection Devices.

G. National Fire Protection Association (NFPA 70: National Electrical Code).

#### 1.04 SUBMITTALS

- A. Submit product data under provisions of Section 26 03 05. Include shop drawings, product data and manufacturer's installation instructions.
- B. The surge suppression submittals shall also include:
1. Copies of Manufacturer's catalog data, technical information and specifications on equipment proposed for use.
  2. Copies of documentation stating that the Surge Protection Device is listed from a Nationally Recognized Testing Laboratory (NRTL) (UL, ETL, etc.) and are tested and multi-listed to UL 1449 and UL 1283.
  3. Copies of actual let through voltage data in the form of oscillograph results for both ANSI/IEEE C62.41 Category 3 (combination wave) and B3 (Ring wave) tested in accordance with ANSI/IEEE C62.45.
  4. Copies of Noise Rejection testing as outlined in NEMA LS1-1993 (R2000) Section 3.11. Noise rejection is to be measured between 50kHz and 100MHz verifying the devices noise attenuation. Must show multiple attenuation levels over a range of frequencies.
  5. Copies of Surge Fuse Testing. Each unit shall be surge tested with fusing in series to verify that a transient of maximum surge current capacity/magnitude is fully suppressed without fuse failure, operation or degradation per NEMA LS1-1992 (R2000) Section 3.9.
  6. Copies of test reports from a recognized independent testing laboratory, capable of producing 200kA surge current waveforms, verifying the suppressor components can survive published surge current rating on both a per mode and per phase basis using the ANSI/IEEE C62.41 impulse waveform C3 (8 x 20 microsecond, 20kV/10kA). Test data on an individual module is not acceptable.
  7. Copy of warranty statement clearly establishing the terms and conditions to the building/facility owner/operator.

#### 1.02 WARRANTY

- A. All TVSS units shall be guaranteed to be free of defects in materials and workmanship for a period of five years from the date of installation.
- B. Any suppressor which fails or operates improperly, even as a result of a direct lightning strike, will be replaced by the manufacturer at no expense to the owner.

#### 1.03 QUALITY ASSURANCE

- A. All suppressors shall be manufactured in the United States by a company normally engaged in the design, development, and manufacture of such devices for electrical and electronics systems equipment for a minimum period of five years.



- B. All manufacturers will provide products which do not interrupt power to the protected system in the event of a suppressor failure, for life safety applications, i.e., fire alarm. Written certification of this parameter shall be provided by the suppressor manufacturer.
- C. The suppressors listed in this specification shall not impair the performance of the protected systems, including, but not limited to, the following parameters: degradation of signal quality or levels, attenuation, and distortion. The suppressors shall not initiate conditions which jeopardize the life safety features of fire alarms, communications, energy management, and other code related protection.

## PART 2 PRODUCTS

### 3.01 SERVICE ENTRANCE AND MAIN DISTRIBUTION PANEL SUPPRESSORS

- A. Suppressors shall be listed in accordance with UL 1449, "Standard for Safety, Transient Voltage Surge Suppressors", and UL 1283, "Electromagnetic Interference Filters".
- B. Suppressors shall be independently tested with the category C3 high exposure waveform (20 kV, 10kA, 8/20 micro-second waveform) clamp voltage test results.
- C. Suppressors shall incorporate copper bus bars for the surge current path. Small round wiring or plug-in connections shall not be used in the path for surge current diversion. Surge current diversion modules shall use bolted connections to the bus bars for reliable low impedance connections.
- D. The unit shall include an engineered solid-state high performance suppression filter system, utilizing metal oxide varistors, and polypropylene capacitors. Units may contain selenium cells to achieve higher ratings.
- E. The unit shall contain 200,000 AIC fuses on each phase.
- F. The status of each phase shall be monitored on the front of the suppressor's enclosure.
- G. For three phase, four wire plus ground configurations, the unit shall provide protection in all modes, Line to Neutral, Line to Ground, Line to Line and Neutral to Ground.
- H. Suppressors shall be equipped with an audible alarm which shall activate upon device failure. An alarm on/off switch shall be provided to silence the alarm and an alarm push-to-test switch shall be provided to test the alarm. The switches and alarm shall be located on the front cover of the suppressor's enclosure.
- I. Suppressor shall meet or exceed the following criteria:

1. Tested maximum single impulse surge current rating per mode shall be:

Line to Line	100,000A
Line to Neutral	100,000A
Line to Ground	100,000A
Neutral to Ground	100,000A

2. Pulse life test: Capable of protecting against and surviving 3500 ANSI/IEEE C62.41 Category C3(20kV, 10 kA) transients without failure or degradation of UL 1449 suppression rating by more than 10%.
3. The UL 1449 suppression rating shall be listed with an integral disconnect switch, where applicable, and shall not exceed the following:

For units with an integral disconnect switch:

VOLTAGE	L-N	L-G	N-G	L-L
120/208	400V	500V	500V	700V
277/480	800V	1000V	900V	1500V

- J. The suppressor shall have a response time no greater than five nanoseconds for any of the individual protection modes.

- K. The unit shall include a high-frequency extended range tracking filter and shall be UL 1283 listed as an electromagnetic interference filter. The filter shall reduce fast rise-time, high frequency, error producing transients. The filter shall provide minimum noise attenuation as follows:

Attenuation Frequency	100KHz	1 MHz	10MHz	100MHz
Attenuation dB	41	31	35	53

- L. Suppressors shall be designed to withstand a maximum continuous operating voltage (MCOV) of not less than 125% of nominal RMS voltage for 120 volt systems.
- M. The unit shall incorporate solid state, long life, externally mounted LED visual status indicators that indicate the on line status of each phase of the unit.
- N. The unit shall incorporate an integral test point allowing easy off line diagnostic testing which verifies the operational integrity of the unit's suppression filter system.
- O. The unit shall include mechanical lugs for each phase, neutral and ground. The lugs shall accommodate up to #4 AWG copper conductor with integral fused disconnect switch, and up to 1/0 AWG copper conductor without an integral fused disconnect switch.

- P. Suppressor manufacturer shall provide certified test data confirming a "fail-short" failure mode.
- Q. Suppressors shall be equipped with the following optional items:
1. Integral Disconnect. The unit shall include an integral disconnect switch located in the unit enclosure with an externally mounted manual operator. The switch shall disconnect all ungrounded circuit conductors from the distribution system to enable testing and maintenance without interruption of power to the facility. The switch shall be rated 600 volt AC. The unit shall be UL 1449 listed with the integral disconnect switch and the UL 1449 suppression rating for this configuration shall be provided.
  2. Disturbance Counter. A transient voltage surge counter shall be located on the front cover of the suppressor. The counter shall be equipped with a manual reset and a battery to retain memory upon loss of AC power.
- R. Acceptable manufacturers:
- Current Technology  
Eaton Innovative Technology  
Square D Surge Logic

### 3.02 208 VOLT AND 480 VOLT SUB PANEL SUPPRESSORS

- A. Suppressors shall be listed in accordance with UL 1449, "Standard for Safety, Transient Voltage Surge Suppressors", and UL 1283, "Electromagnetic Interference Filters".
- B. Suppressors shall be independently tested with the category C3 high exposure waveform (20 kV, 10kA, 8/20 micro-second waveform) clamp voltage test results.
- C. Suppressors shall incorporate copper bus bars for the surge current path. Small round wiring or plug-in connections shall not be used in the path for surge current diversion. Surge current diversion modules shall use bolted connections to the bus bars for reliable low impedance connections.
- D. The unit shall include an engineered solid-state high performance suppression filter system, utilizing metal oxide varistors, and polypropylene capacitors.
- E. The unit shall contain 200,000 AIC fuses on each phase.
- F. The status of each phase shall be monitored on the front of the suppressor's enclosure.
- G. For three phase, four wire plus ground configurations, the unit shall provide protection in all modes, Line to Neutral, Line to Ground, and Neutral to Ground.

H. Suppressors shall be equipped with an audible alarm which shall activate upon device failure. An alarm on/off switch shall be provided to silence the alarm and an alarm push-to-test switch shall be provided to test the alarm. The switches and alarm shall be located on the front cover of the suppressor's enclosure.

I. Suppressor shall meet or exceed the following criteria:

1. Tested maximum single impulse surge current rating per mode shall be;

Line to Line	80,000A
Line to Neutral	80,000A
Line to Ground	80,000A
Neutral to Ground	80,000A

2. Pulse life test: Capable of protecting against and surviving 2500 ANSI/IEEE C62.41 Category C3(20kV, 10 kA) transients without failure or degradation of UL 1449 suppression rating by more than 10%.

3. The UL 1449 suppression rating shall be listed with an integral disconnect switch, where applicable, and shall not exceed the following:

For units without an integral fused disconnect switch:

VOLTAGE	L-N	L-G	N-G	L-L
120/208	400V	500V	500V	700V
277/480	900V	1000V	800V	4800V

J. The suppressor shall have a response time no greater than five nanoseconds for any of the individual protection modes.

K. The unit shall include a high-frequency extended range tracking filter and shall be UL 1283 listed as an electromagnetic interference filter. The filter shall reduce fast rise-time, high frequency, error producing transients. The filter shall provide minimum noise attenuation as follows:

Attenuation Frequency	100KHz	1 MHz	10MHz	100MHz
Attenuation dB	41	31	35	53

L. Suppressors shall be designed to withstand a maximum continuous operating voltage (MCOV) of not less than 125% of nominal RMS voltage for 120 volt systems.

M. The unit shall incorporate solid state, long life, externally mounted LED visual status indicators that indicate the on line status of each phase of the unit.

N. The unit shall incorporate an integral test point allowing easy off line diagnostic testing which verifies the operational integrity of the unit's suppression filter system.

- O. The unit shall include mechanical lugs for each phase, neutral and ground. The lugs shall accommodate up to #4 AWG copper conductor with integral fused disconnect switch, and up to 1/0 AWG copper conductor without an integral fused disconnect switch.
- P. Suppressor manufacturer shall provide certified test data confirming a "fail-short" failure mode.
- Q. Acceptable manufacturers:
  - Current Technology
  - Eaton Innovative Technology
  - Square D Surge Logic

### 3.03 TERMINAL STRIP HARD-WIRED (120 VAC) SUPPRESSORS

- A. Suppressors shall be listed in accordance with UL 1449, "Standard for Safety, Transient Voltage" "Surge Suppressors".
- B. Suppressors shall consist of a three stage hybrid design: first stage - MOV, second stage - inductor, third stage - silicon avalanche diode or MOV.
- C. Suppressors shall be internally fused in such a manner that power to protected equipment is not interrupted in the event of a suppressor failure.
- D. Suppressors shall provide three suppression paths: line to neutral, line to ground, and neutral to ground.
- E. Suppressors shall provide a maximum single impulse current rating of 25 kA (8/20 micro-second waveform) per mode.
- F. Pulse life rating: Capable of protecting against and surviving 500 Category B3 transients (6 kV - 1.2/50 micro-second, 3 kA - 8/20 micro-second waveform).
- G. Suppressors' maximum clamping voltage when subjected to Category B3 transients shall not exceed 350 V peak.
- H. Visible indication of proper suppressor connection and operation shall be provided.
- I. The suppressor shall have a two year warranty.
- J. Acceptable manufacturers: Advanced Protection Technologies, Inc., Model TE/AC03UL, or approved equal.

### 3.04 INTERCOM CIRCUIT SUPPRESSORS

- A. Suppressors shall meet the following requirements:
  - 1. UL 497B listed and labeled.
  - 2. Utilize a multi-stage hybrid protection circuit.
  - 3. Consist of a plug-in replaceable modular design or individually mounted units.
  - 4. Designed for a fail-short mode of failure.
  
- B. Electrical Requirements
  - 1. Maximum single impulse current: 200 A (10/1000 micro-second waveform).
  - 2. Clamp voltage: not to exceed 150% of circuit peak operating voltage (100 A, 10/1000 micro-second waveform).
  - 3. Maximum continuous operating voltage: 125% of peak operating voltage, minimum.
  - 4. Capacitance for DC or low frequency lines shall not exceed 2000 pF (measured line to ground at the rated diode breakdown voltage).
  - 5. Pulse life: 200 impulses of 50 A (10/1000 micro-second waveform)
  
- C. Acceptable manufacturers: Advanced Protection Technologies, DA Series

### 3.05 SECURITY SYSTEMS

- A. Suppressors shall meet the following requirements:
  - 1. UL 497B listed and labeled.
  - 2. Utilize a multi-stage hybrid protection circuit.
  - 3. Consist of a plug-in replaceable modular design or individually mounted units.
  - 4. Designed for a fail-short mode of failure.
  
- B. Electrical Requirements
  - 1. Maximum single impulse current: 200 A (10/1000 micro-second waveform).
  - 2. Clamp voltage: not to exceed 150% of circuit peak operating voltage (100 A, 10/1000 micro-second waveform).
  - 3. Maximum continuous operating voltage: 125% of peak operating voltage, minimum.
  - 4. Capacitance for DC or low frequency lines shall not exceed 2000 pF (measured line to ground at the rated diode breakdown voltage).
  - 5. Pulse life: 200 impulses of 50 A (10/1000 micro-second waveform)
  
- C. Acceptable manufacturers: Advanced Protection Technologies, DA Series, or approved equal.

### 3.06 COAXIAL CABLE SUPPRESSORS

- A. Suppressors shall be installed on each generic or unspecified system coaxial cable on points of entry to or exit from separate buildings, and at roof mounted and other locations where direct exposure to lightning occurs. Suppressors shall meet the following criteria.
  - 1. Shunt clamping elements: gas tubes and high energy bipolar silicon avalanche

diodes separated by a series resistance.

2. Electrical Parameters:
  - a) Impedance: match the system being protected.
  - b) Capacitance: 10 pF.
  - c) Maximum single impulse current: 10 KA (8/20 micro-second waveform), minimum.
  - d) Clamping voltage: not to exceed 200% of normal peak operating voltage.
3. Response time: less than one nanosecond.

B. Acceptable manufacturers: Advanced Protection Technologies; TE9025, or approved equal.

## PART 3 EXECUTION

### 3.01 GENERAL

- A. Install TVSS equipment according to manufacturer's recommendations.
- B. Contractor shall properly match TVSS equipment to equipment being protected, including wire sizes, operating voltages and currents.
- C. Contractor shall coordinate with providers of all equipment being protected and provide TVSS equipment which meets these specifications.
- D. Provide required NEMA 1 (indoor) or NEMA 3R (outdoor) enclosures for suppressors adjacent to each electronic system cabinet, or coordinate with each electronic system supplier to provide oversized cabinets to incorporate suppressors into electronic systems cabinet.
- E. Electronic system equipment shall be protected by treating groups of related devices as a "cluster" and protecting all hard wire circuits which enter and leave the cluster. All equipment chassis within a protected cluster shall be bonded to a ground bar at the "window" location for the cluster, the window being the common point where all hard wire circuits enter or leave the cluster.

### 3.02 SERVICE ENTRANCE AND MAIN DISTRIBUTION PANELS AND MCC'S

- A. Install one primary suppressor at each utility service entrance to the facility, according to manufacturer's recommendations.
- B. Install one primary suppressor at each main distribution panel for each voltage in use at the facility, according to manufacturer's recommendations.
- C. Install one primary suppressor at each motor control center for each voltage in use at

the facility, according to manufacturer's recommendations.

- D. The suppressor shall be installed on the load side of the service entrance.
- E. Conductors between suppressor and point of attachment shall be kept short and straight.
- F. Suppressor's ground shall be bonded to the service entrance ground.

### 3.03 208 VOLT AND 480 VOLT SUB PANELS

- A. Install one secondary suppressor at each sub panel location, according to manufacturer's recommendations.
- B. Conductors between suppressor and point of attachment shall be kept short and straight.
- C. Neutral and ground shall not be bonded together at secondary panelboard locations.
- D. Provide suitable three pole breaker in all panels as recommended by suppression manufacturer to connect unit.

### 3.04 ELECTRONIC EQUIPMENT (120 VAC) POWER SUPPLY

- A. Install one each hard-wired branch circuit suppressor between each of the following equipment items and its power supply conductors.
  - 1. Each Building Fire alarm control panel.
  - 2. Master Intercom panel.
  - 3. Each Building Energy Management and Control system panel.
- B. Install suppressor according to manufacturer's recommendations.

### 3.05 COAXIAL CABLE SYSTEMS

- A. Suppressors shall be installed on each cable TV coaxial cable system on points of entry to or exit from separate buildings, and at roof mounted equipment and other locations where direct exposure to lightning occurs.

### 3.06 GROUND INSTALLATION

- A. Ground Bus Connections
  - 1. Provide local ground bus in each terminal cabinet housing surge protection equipment (with other materials as required).
  - 2. Bond local ground bus to terminal cabinet with minimum #6 copper wire.
  - 3. Connect terminal cabinet local ground bus to systems ground bus with minimum #6 copper insulated wire (unless otherwise noted) in conduit.
  - 4. Note that the systems ground bar is also to be used for power transformation ground (480 V to 208 V) where applicable.



B. Surge Suppression Equipment Grounding

1. Connect each suppressor to local ground bus in terminal cabinet with wire sized as recommended by manufacturer. Where M block type terminations/suppressors are used, bond ground rail to local ground bar with wire as recommended by manufacturer.
2. Ensure that 120 VAC power source/supply suppressor is also grounded to same local ground bus as suppressors provided in this section for same system (i.e., fire alarm, intercom, television, etc.).

C. Grounding Conductors

1. Conductors shall be a minimum size of #12 THWN (in conduit, insulated) unless otherwise noted or otherwise recommended by the manufacturer.
2. Conductors shall be as short as possible.
3. No bend radius shall be less than 6 inches or more than 90 degrees.
4. Conductors shall be secured at 12 inch intervals with an approved copper clamp.
5. Grounding conductors shall be properly connected to the building service ground by approved clamps.
6. Do not bundle unprotected conductors with protected conductors.

D. Grounding Connectors

1. Connectors, splicers, and other fittings used to interconnect grounding conductors, or bond to equipment or grounding bars, shall be approved by UL or NEC for the purpose.
2. All connectors and fittings shall be of the one time crimp or compression set-screw type solderless connection.
3. Special treatment to fittings, lugs, or other connectors of dissimilar material shall be applied to prevent electrogalvanic action.

END OF SECTION 263555



## SECTION 26 51 10

### LED LIGHTING FIXTURES

#### PART 1 GENERAL

##### 1.01 WORK INCLUDED

- A. Interior luminaires and accessories.
- B. Exterior luminaires and accessories.
- C. LED Modules.
- D. LED Drivers.

##### 1.02 REFERENCES

- A. UL Standard 8750 "Light Emitting Diode Equipment for Use in Lighting Products".
- B. IES Standard LM-79 "Electrical and Photometric Measurements of Solid-State Lighting Products".
- C. IES Standard LM-80 "Measuring Lumen Maintenance of LED Light Sources".
- D. IES Standard TM-21 "Projecting Long Term Lumen Maintenance of LED Light Sources".
- E. ANSI C78.377 "Specifications for the Chromaticity of Solid State Lighting products" with LEDs binned within a maximum three-step MacAdam Ellipse to ensure color consistency amongst luminaires of the same type.

##### 1.03 SUBMITTALS

- A. Submit product data under provisions of Section 260305.
- B. Include outline drawings, LED module and driver data, support points, weights, and accessory information for each luminaire type.

##### 1.04 DEFINITIONS

- A. BF: Ballast Factor.
- B. CCT: Correlated color temperature.
- C. CRI: Color-rendering index.

- D. HID: High-intensity discharge.
- E. LER: Luminaire efficacy rating.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting fixture, including ballast housing if provided.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Section 260305-1.07.
- B. Store and protect products under provision of Section 260305-1.07.

#### 1.06 QUALITY ASSURANCE

- A. Lighting fixtures shall be of specification grade and listed or labeled by Underwriters Laboratories (UL) or an approved Nationally Recognized Testing Laboratory (NRTL).

#### 1.07 WARRANTY

- A. For LED fixtures, lamps, drivers, and components, provide a complete warranty for parts and labor for a minimum of five years from the date of Substantial Completion.

### PART 2 PRODUCTS

#### 2.01 LED LUMINARIES AND ACCESSORIES

- A. Luminaries shall be as scheduled on the drawings.
- B. Catalog numbers indicated in the Luminaire Schedule are a design reference. Provide complete luminaires as scheduled to correspond with the features, accessories, number of lamps, wattage and/or size defined by the manufacturer's catalog number listed.
- C. Submit all substitutions for approval by the Architect and Engineer prior to bid.
- D. LED fixtures shall be modular and allow for separate replacement of LED lamps and drivers. User serviceable LED lamps and drivers shall be replaceable from the room side.

#### 2.02 LEDS

- A. LED modules shall have a color temperature of 4000 degrees K, a CRI of 80 minimum, and a lumen maintenance L70 rating of 50,000 hours minimum.

- B. Retrofit LED lamps shall comply with NEMA SSL 4 “SSL Retrofit Lamps: Suggested Minimum Performance Requirements”.

## 2.03 DRIVERS

- A. LED drivers shall be electronic-type, labeled as compliant with radio frequency interference (RFI) requirements of FCC Title 47 Part 15, and comply with NEMA SSL 1 “Electronic Drivers for LED Devices, Arrays, or Systems”. LED drivers shall have a sound rating of “A”, have a minimum efficiency of 85%, and be rated for a THD of less than 20 percent at all input voltages.
- B. Drivers shall be solid state and accept 120 through 277 VAC at 60 Hz input.
- C. Dimmable LED drivers shall be 0-10V type. Dimmable LED drivers shall be capable of dimming without LED strobing or flicker across their full dimming range.
- D. Drivers shall be rated for the ambient temperatures in which they are located. Outdoor fixtures shall be equipped with ballasts or drivers rated for reliable starting to -20 degrees F. Indoor fixtures located in areas with direct sunlight or above normal ambient temperatures shall have ballasts or drivers rated at 65 degrees C minimum.

## 2.04 EMERGENCY LIGHTING

- A. Emergency lighting shall consist of normal lighting fixtures with generator system backup.

## 2.05 EXIT SIGNS

- A. Exit signs shall be of the LED type, connected to the emergency generator system.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install lamps in luminaires and lamp holders.
- B. Support surface-mounted luminaires directly from building structure or fasten to T grid using bolts, screws, rivets, or approved ceiling framing member clips.
- C. Support recessed troffers independently of the ceiling grid system by using two safety wires minimum on diagonally opposite corners of the fixtures. Removable T-bar clips shall not be used to attach fixtures to the ceiling grid system.
- D. Support recessed downlights by using safety wires or by rigidly attaching the fixtures to the building structure or ceiling grid system.

- E. Install fixtures level, with no gaps between adjacent fixtures or between fixtures and surrounding surfaces. Lenses, reflectors, and trims of fixtures shall be properly and uniformly aligned.
- F. Install recessed luminaires to permit removal from below.
- G. Provide an individual feed with ground conductor from a junction box to each group of switched lighting fixtures. Lighting fixtures may be daisy-chained.
- H. Drops to recessed fixtures may be flexible metallic conduit, or manufactured wiring systems may be used where accessible. Fixtures shall be provided with sufficient length to permit removal and lowering of the fixtures 12” below the ceiling.
- I. Provide green grounding conductors back to the panel ground for lighting circuits. Raceways shall not be used as grounding conductors.
- J. Aim all adjustable luminaires to provide intended lighting and uniform lighting levels within space.

### 3.02 EXTERIOR LUMINAIRES

- A. Install exterior luminaires in accordance with manufacturer's installation instructions.
- B. Support from four inch square outlet box with plaster ring and from wall at non-feed ends with expansion anchors and bolts or toggle bolts. Don not use plastic anchor inserts.
- C. Provide clear silicone sealant at tops of wall mounted fixtures, around wall outlet boxes and on unused openings in fixture housings to create waterproof seal and eliminate water intrusion into fixture.

### 3.03 ADJUSTING AND CLEANING

- A. Align luminaires and clean lenses and diffusers at completion of Work. Clean paint splatters, dirt, and debris from installed luminaires.
- B. Adjust all occupancy controls to shut off lights in Code required time after room is vacated.
- C. Adjust day lighting controls to dim controlled lights to maintain minimum classroom lighting level of 50 foot candles.

### 3.04 TRAINING

- A. Train Owner's maintenance personnel on equipment operation, startup and shutdown,

trouble-shooting, servicing, and preventative maintenance procedures. Demonstrate operation of all lighting fixtures on occupancy sensor switches, day lighting controllers and dimmers. and dimming Review the data contained in the Operating and Maintenance Manuals with Owner's personnel. Training shall occur separate from startup activities.

### 3.05 LUMINAIRE SCHEDULE

- A. Luminaries as scheduled on the Drawings are the basis for the lighting design.
- B. Substitutions may be made according to specifications sections 002113, "Instructions to Bidders" and 016000, "Product Requirements."

END OF SECTION 265110





## SECTION 27 13 43

### COMMUNICATIONS CIRCUIT PATHWAYS

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Section includes arrangement with Telecommunications Utility Company for telecommunication service; payment of Utility Company charges for service installation; and backboards, cabinets, cable tray, raceways, and boxes.
- B. Related Sections:
  - 1. Section 09 90 00 - Painting: Painting backboards.
  - 2. Section 09 90 00 - Painting and Coating: Painting backboards.
  - 3. Section 26 05 34 - Floor Boxes for Electrical Systems.
  - 4. Section 26 27 26 - Wiring Devices: Wall plates.
  - 5. Section 26 05 26 - Secondary Grounding and Bonding
  - 6. Section 27 05 33 - Conduits and Backboxes for Communications Systems.

##### 1.02 REFERENCES

- A. International Electrical Testing Association:
  - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- B. Telecommunications Industry Association/Electronic Industries Alliance:
  - 1. TIA/EIA 568 - Commercial Building Telecommunications Cabling Standard.
  - 2. TIA/EIA 569 - Commercial Building Standard for Telecommunications Pathways and Spaces.
- C. American Society for Testing and Materials:
  - 1. ASTM A123 - Specification for Zinc (hot dipped galvanized coatings on iron and steel).
  - 2. ASTM A510 - Specification for general requirements for wire rods and course round wire, carbon steel.
  - 3. ASTM B633 - Specification for electro-deposited coatings of zinc on iron and steel.
- D. National Electrical Manufacturers Association:
  - 1. NEMA VE2-2000 - Cable tray installation guidelines.

##### 1.03 SYSTEM DESCRIPTION

- A. Service entrance from Telecommunications Utility Company.

- B. Service Entrance Pathway: Empty ducts and raceway from point of Telephone Utility connection at property line to building service terminal backboard.
- C. Entrance Wiring: By Telephone Utility Company.
- D. Backbone Wiring: By Owner.
- E. Horizontal Wiring: By Owner.

#### 1.04 SUBMITTALS

- A. Section 26 03 05 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit catalog data for cable tray, raceways and boxes.

#### 1.05 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations and sizes of pathways and outlets.

#### 1.06 COORDINATION

- A. Contact utility company regarding charges related to service installation. Include utility charges in this contract.

### PART 2 PRODUCTS

#### 2.01 TELEPHONE TERMINATION BACKBOARDS

- A. Material: Fire retardant Plywood.
- B. Size: As indicated on Drawings, 3/4 inch thick.

#### 2.02 TELEPHONE/DATA OUTLETS

- A. Provide telephone/data outlets consisting of 4 inch square X 1-1/2 inch deep box with single gang plaster rings where shown.
- B. Provide 3/4 inch conduit from box to above ceiling and turned out perpendicular to wall, 6 inches from wall with plastic bushing attached to conduit or connector.
- C. Provide a pull string in all conduits.

#### 2.03 TELEPHONE/DATA FLOOR OUTLETS

- A. Provide conduit underfloor from communication section of floor boxes to telephone terminal boards. Conduits shall extend above finished floor 12 inches.
- B. Provide plastic bushing on all underfloor conduits.
- C. Provide pull string in all conduits.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install pathways in accordance with TIA/EIA 569.
- B. Finish paint termination backboards with durable white enamel in accordance with Section 09 90 00 prior to installation of any equipment.
- C. Install termination backboards and cabinets plumb, and attach securely to building wall at each corner.
- D. Install polyethylene pulling string in each empty telephone conduit over.
- E. Install engraved plastic nameplates in accordance with Section 26 05 53. Mark backboards and cabinets with legend "TELEPHONE."
- F. Ground and bond pathways, cable shields, and equipment in accordance with Section 26 05 26.

END OF SECTION

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## SECTION 27 13 46

### LOCAL AREA NETWORK FIBER OPTIC CABLING

#### PART 1 GENERAL

##### 1.01 GENERAL

- A. Where indicated on the contract plans, furnish and install complete with all accessories an EIA/TIA Category 5 Fiber Optic cable backbone to be used for but not limited to IEEE 802.3 10 Base-T Ethernet, EMCS intra-building communications, Networked Intercom Communications and Networked Fire Alarm Communications

##### 1.02 REFERENCES

- A. EIA/TIA-568 - Commercial Building Telecommunications Wiring Standard. Horizontal Cable Section.
- B. NEMA.
- C. National Electric Code.
- D. IEEE 802.3, 10 Base-T Ethernet.
- E. ANSI X3T9.5 Requirements for UTP at 100 Mbps.

##### 1.03 SUBMITTALS

- A. Submit under provisions of Section 16011.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, technical information, and configurations. Provide data for the following:
  - 1. Fiber optic cable.
  - 2. Fiber optic connectors.
  - 3. Fiber optic patch panels.
  - 4. Fiber optic patch cords.

##### 1.04 Manufacturer's Instructions:

- A. Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements.
- B. Include instructions for storage, handling, protection, examination, preparation, operation and installation of product.

## 1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three (3) years experience.
- B. Contractor: The contractor shall be experienced in all aspects of the work to be performed.

## 1.06 WARRANTY

- A. Provide preventive maintenance for a period of 1 years from Date of Final Acceptance. Service shall include full replacement cost including material and labor required to replace any failed component. Include annual inspection of entire system.

## PART 2 PRODUCTS

### 2.01 CABLES

#### A. Exterior Fiber Optic Cable

1. Fiber optic cable for underground use shall be used to interconnect the MDF and IDF's between buildings. The cable shall be a multimode, loose tube, single jacket cable rated for indoor/outdoor use. The cable shall have a central core with strength members located outside the central core tube containing the optical fibers. Cable shall be plenum rated type OFNP.
2. Optical fibers. Each cable shall contain 12 or 24 fibers as shown on the drawings. Fibers shall be dual coated to protect against microbending, provide mechanical protection and color retention, improve fatigue resistance, and enhance stripability. Coating shall consist of a low modulus inner layer and a high modulus outer diameter.
3. Fiber strength. Fiber strength shall have a minimum proof test level of 50,000 psi, tested per method EIA-TIA-455-31b, "Fiber Tensile Proof Test Method.
4. Multimode Fiber Specifications. (62.5/125)
  - a. Fiber Core 62.5 +/- 3 micron
  - b. Cladding Diameter 125 +/- 2 micron
  - c. Attenuation (db/Km at 850 nm) Max. 3.75 db/Km
  - d. Attenuation (dB/Km at 1300nm) Max. 1.00 dB/Km
  - e. Bandwidth (Mhz-Km at 850 nm) Min. 160 Mhz-Km
  - f. Bandwidth (Mhz-Km at 1300 nm) Min. 500 MHz-Km
  - g. Core Non-Circularity Less than 6%
  - h. Cladding Non-Circularity Less than 2%

- i. Concentricity error Less than 6%
  - j. Primary Coating Material UV curable acrylate
  - k. Primary Coating Diameter Nom. 250 micron
5. Cable Core. The cable core shall be a group of twelve fibers with two helically applied opposing binders. The fibers and binders shall be color coded to facilitate positive fiber identification. The cable core shall consist of an extruded high density polyethylene(HDPE) jacket covering the fiber bundle.
6. Cable Sheath. The overall cable jacket shall cover the central core, strength members and rip cords. The jacket shall be plenum rated type PVDF.

## 2.02 FIBER OPTIC DISTRIBUTION CENTERS (FDC'S)

- A. All MDF and IDF fiber optic cabling shall be terminated in rack mount ST Fiber Distribution Enclosures. Provide a new FDC at each IDF to terminate new cables. Each FDC shall contain two (2) 12 port type SC connector panels. All FDC's shall be provided with rack mounting hardware allowing the unit to be placed in a standard EIA 19" rack. Provide sufficient port quantity using ST connector panels to allow termination of all fiber optic strands.
- B. Provide blanking modules in all unused connection ports.
- C. Labeling for fiber cabling shall be by IDF number, plus the color suffix designating which fiber is terminated. Die cut acetate labels or Kroy labels shall be considered acceptable for the purpose.
- D. FDC's shall be constructed of minimum 16 gauge steel and shall have cable tie down bars and grounding clamps. FDC's shall be painted with light blue enamel paint.
- E. Manufacturers: AMP, Ortronics, Siecor.

## 2.03 PATCH CABLE

- A. Distribution Frame Fiber Optic Patch Cords: Pre-assembles multimode, 62.5/125 micron, duplex fiber optic cable with four (4) SC style connectors and plenum rated outer jacket. Cable shall be three (3) feet total length. Cable ends shall be labeled with transmit and receive markers. Provide one (1) patch cord for every pair of fibers terminated at each IDF.

## 2.04 FIBER OPTIC CONNECTORS

- A. Fiber optic connectors shall be type SC, of the hot melt installation type. Crimp type connectors are not acceptable. Connectors shall be preloaded with all necessary adhesive to achieve a permanent connection. Adhesive shall be reheatable to allow fiber repositioning. Connector boot shall be Thermoplastic Elastomer. Connector Housing

and Body shall be Engineered Resin Material. Connector Ferrule shall be Zirconia Ceramic. Insertion Loss Typical Field Mount (one mated pair) @ 1300 nm: <0.2dB. Reflection Typical Field Mount: -25dB

- B. Manufacturers: 3M or equal.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Inspect wire and cable for physical damage and proper connection. Replace damaged cables.

### 3.02 INSTALLATION

- A. Install all cable between buildings in conduit as specified in Section 26 05 32 "Conduit". Bending radii shall not be less than the cable manufacturer's minimum bending radius for the installed cable.
- B. Cables in communications rooms shall be neatly routed from entry conduit to LAN rack using wire management devices secured to the communication room backboards. Free hanging cables shall not be allowed.
- C. Fiber Optic Cable shall be terminated on a rack mounted patch panel.
- D. Cables shall be installed unbroken from originating point to end use point. Terminate all cables using specified connectors. Spare conductors shall be suitably marked at each end to identify individual components for future use.
- E. Splices: Splices shall not be permitted. All fiber optic conductors shall be terminated at a fiber optic patch panel.
- F. Metallic Component Grounding: Fiber optic cable system metallic components including tube routing panels and fiber termination patch panels shall have the metallic components grounded at the cable termination points.

### 3.03 TESTING

- A. Fiber Optic Cable Test: Verify complete operation of data transmission system during field testing. Perform test on 100 percent of the fibers. Field tests shall include as a minimum:
- B. Optical time domain reflectometer (OTDR) test at 850 and 1300 nanometers. Calibrate OTDR to show anomalies of 0.2 dB as a minimum. Reterminate cable or replace and



- C. Perform power attenuation test at light wavelength of the transmitter to be used on the circuit being tested. Measure flux at the Fiber Optic receiver end and compare to the flux injected at the transmitter end. Provide a jumper at each end of the circuit under test to validate end connector loss. Rotational optimization of the connectors will not be permitted. Circuit loss shall not exceed the calculated circuit loss by more than 2 dB. When test is unsatisfactory, examine circuit to determine the problem. Notify Contracting Officer of the problem and proposed procedures to eliminate the problem.

### 3.04 LABELING

- A. Pathways shall be labeled at all endpoints located in telecommunication closets, equipment rooms, and other facilities. Additional labeling may be desirable at intermediate locations, or regularly spaced throughout the length of the pathway.
- B. Labeling must withstand the performance requirements of UL 969 as outlined in TIA standard.
- C. Station labeling shall be visible and distinguishable from a distance of 4 feet.

END OF SECTION



## SECTION 27 13 48

### LOCAL AREA NETWORK PREMISE DISTRIBUTION SYSTEM

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 and Division 16 Specification Sections apply to this Section.
- B. Standards - Conform to the requirements of the following:
  - 1. TIA/EIA-568-B.1 "Commercial Building Telecommunications Cabling Standard", CSA T529.
  - 2. TIA/EIA-568-B.2-1 "Transmission Performance Specifications for 4-pair 100 Ohm Category 6 Cabling".
  - 3. TIA/EIA-569 "Commercial Building Standard for Telecommunications Pathways and Spaces", CSA T530.
  - 4. TIA/EIA-606 "Administration Standard for Telecommunications Infrastructure of Commercial Buildings", CSA T528.
  - 5. TIA/EIA-607 "Commercial Building Grounding/Bonding Requirements".
  - 6. TSB-67 "Transmission Performance Specification for Field Testing of Unshielded Twisted Pair Cabling Systems".
  - 7. TIA/EIA TSB-72 "Centralized Optical Fiber Cabling Guidelines".
  - 8. TIA/EIA PN-3398 TSB-75 "Additional Horizontal Cabling Practices for Open Offices".
  - 9. ANSI/NFPA 70 National Electrical Code, CSA C22.1.
  - 10. BICSI Telecommunications Distribution Methods Manuals
  - 11. BICSI Telecommunications Installation Manuals
  - 12. County Codes and Regulations.
  - 13. Underwriters Laboratories (UL)
  - 14. FCC -Federal Communications Commission
  - 15. ADA Requirements
  - 16. Occupational Safety and Health Regulations (OSHA)
  - 17. National Fire Protection Association (NFPA)
  - 18. Florida Statutes and Administrative Rules
  - 19. Cabling System Certified Cabling Catalog

20. American Society for Testing and Materials (ASTM)
21. EIA/TIA-492AAAA - Detail Specification for 62.5 Micrometer Core Diameter/125 Micrometer Cladding Diameter Class 1a Multimode, Graded Index Optical Waveguide Fibers.
22. EIA/TIA TSB-36 - Technical Systems Bulletin, Additional Transmission Specifications for Unshielded Twisted Pair Cables.
  
23. EIA/TIA TSB-40-A - Technical Systems Bulletin, Additional Transmission Specifications for Unshielded Twisted Pair Connecting Hardware.
24. Florida DMS/DOC - General Facility Requirements for Telecommunications Systems
25. LPC - Lightning Protection Code (NFPA-780).
26. UL Certified - UL's LAN Cable Certification Program. UL 910 - Test for Flame Propagation and Smoke Density Values for Electrical and Optical Fiber Cables Used in Spaces Transporting Environmental Air.
27. UL 1666 - Test for Flame Propagation Height of Electrical and Optical Fiber Cables Installed Vertically in Shafts.
28. UL 1449, 3<sup>rd</sup> Edition – Standard for Safety for Surge Protective Devices
29. UL 497, UL 497A, UL 497B
30. ANSI - American National Standards Institute
31. NEMA - National Electrical Manufacturers Association
32. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

## **1.02 PERFORMANCE REQUIREMENTS**

- A. General: Provide for a complete (furnish and install) EIA/TIA 568-B.2-1 Category 6 Premise Distribution System (PDS) with all accessories and a minimum 20-year LINK AND CHANNEL WARRANTY for the entire system. The goal is to provide an enhanced PDS system that will serve as a vehicle for transport of data, video and voice telephony signals throughout the building and from building to building from a designated demarcation point to outlets located at various desks, workstations and other locations.
- B. Support analog and digital voice applications, data, local area networks (LAN), video and low voltage devices for building controls and management on a common cabling platform. The applications supported include, but are not limited to:
  1. Data Processing – EIA-232-D, EIA-422A, EIA-43-A, RS-485, Star LAN, Fiber Distributed Data Interface (FDDI), Ethernet 10Base-T (IEEE 802.3i), 10Base-F (IEEE 802.3j), and TP-PMD. In addition, these links/channels shall be capable of

supporting high-end applications such as 100Base-T (IEEE 802.3u), 1000Base-T (IEEE 802.3z, ab), and 1000 base TX.

2. Voice Applications – Lucent, Northern Telecom, NEC, SIEMENS.
  3. Video – Broadband and base band Analog Video, Digital Video, and Video Conferencing.
  4. WLAN applications, cabling for Wireless Access Points (WAP), shall be compliant with applicable EIA/TIA standards, as well as the IEEE 802.3af standard for providing PoE, (Power over Ethernet) for Data Terminal Equipment (DTE) over Category rated UTP cable.
  5. Other Applications: ISDN, ATM, ADSL, VoIP
- C. Provide a network of unshielded twisted pair cables (UTP) and fiber optic cables (FO) for horizontal cabling, backbone cabling, riser cabling, tie cabling, and patch cords. Provide and locate terminations and quantities on contract drawings. Terminate FO Cables on rack mounted Fiber Distribution Centers (FDC's), and UTP cables on rack mounted modular patch panels. Identify all cables and terminations in accordance with EIA/TIA 606 using an alphanumeric sequence.
- D. At a minimum provide all terminations and testing in accordance with EIA/TIA 568.2-1, Category 6, with at least a 20-year warranty.
1. Provide an installation that requires horizontal cable supporting data applications must meet at a minimum the Category 6 performance requirements as listed by EIA/TIA standards for the link and channel. (Field testing for LINK only, 100% factory patch cord testing required).
- E. Data communications is to originate at Owner provided switches and routers located at individual IDF'S.
- F. Wiring, terminations and patch bays between designated demarcation points and outlet locations is to be considered part of the contract. Outlets (jacks) shall be furnished, wired, and installed by the Structured Cable Systems (SCS) Contractor.
- G. Nassau County School District has standardized on the following color code for category 6 components.
1. All category 6 cable shall be green in color

### **1.03 QUALITY ASSURANCE**

#### **A. Installer Qualifications:**

1. Any contractor who chooses to bid on this project must show current certification as an installer of the specified connectivity manufacturer.
2. Provide that the Contractor responsible for the work is a "Premise Distribution Wiring Contractor" who is, and who has been, regularly engaged in the providing and installation of commercial and industrial telecommunications wiring systems of this type and size for at least the immediate past five years, holds a valid Florida Certified Limited Energy System Specialty license (ES 069) and possess either a Panduit Certified Installer or AMP Netconnect Design & Installation and

Corning Extended Warranty Program Certifications in order to provide the level of warranty for the product sets required.. Also, any sub-Contractor, who will assist the PDW Contractor in performance of this work, is to have the same training and certification as the PDW Contractor. A copy of the sub-contractors connectivity manufacturer certification shall be submitted to Nassau County School District prior to the commencement of work.

3. BICSI Accreditation: Provide that the Contractor's Project Manager be a member in good standing with and possess a current BICSI Registered Communications Distribution Designer (RCDD) certificate.
4. Experienced: Provide that the Contractor be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size. The Contractor is to own and maintain tools and equipment necessary for successful installation and testing of optical fiber and Category 6 copper premise distribution systems and have personnel who are adequately trained in the use of such tools and equipment.

#### **1.04 SUBMITTALS DURING CONSTRUCTION**

- A. Adherence to Specifications: Manufacturers and/or products are listed in no order of preference and only referenced as acceptable. Single manufacturer names means that no other manufacturer's product is accepted without written approval from Nassau County School District and the Engineer. These manufacturers represent major components and are not intended to be comprehensive. Shop drawings and/or samples for all products not listed must be submitted to Nassau County School District for approval. Also, an explanation in detail giving the reason(s) why and how the proposed items will meet the specifications and will not be considered an exception, and submit adequate information to support this claim. Nassau County School District reserves the right to be the sole judge of what is equal or equivalent. These changes, if approved by the OWNER and the ENGINEER, must be issued in a WRITTEN ADDENDUM not later than seven (7) days prior to bid opening date.
- B. Required to be submitted with the bid:
  1. Copy of the Contractor's current Certification by the specific connectivity manufacturer.
- C. Submittals required prior to the commencement of work: Include manufacturers' cut sheets for all proposed equipment including, but not limited to, the following:
  1. All wire and cable as specified by the contract documents.
  2. All connectors and required tooling.
  3. All terminations system components for each cable type.
  4. All IDF equipment frame types, hardware and surge strips.
  5. All cable suspension J-hooks, cable fasteners, CAT 6 cable suspension components.
  6. All grounding and surge suppression system components for the system portion of the project.

7. AC Grade, Plywood Backboards painted with UL Classified fire retardant paint.
8. All CAT 6 patch cords.

D. As-Built Documentation

1. Provide as-built documentation in accordance with Division 01.
2. As part of the as-built documentation provide all cable routings (trunk lines) and elevations of each IDF or MDF indication outlet, tie, and riser cable terminations.
3. Provide EXCEL software spreadsheet that defines the telecommunications outlet number, location, and number of voice, data and special jacks. This database is to also include outlet patch panel connection to the riser/inter-floor cable, equipment, and telephone company demarcation circuit pairs.

E. Warranty Requirements:

Cabling system warranties are to be supplied by the manufacturer of the connectivity, (jacks, patch panels and patch cords). The warranty program shall include coverage for both Link and Channel configuration as specified in the connectivity manufacturer's warranty. The patch cords and workstations cords shall be manufactured by the same manufacturer as the jacks and patch panels. The patch cords shall be 100% factory tested for compliance to the Category 6 standard. The warranty shall provide for guaranteed system performance, provide for material replacement and the labor to re-install defective products.

## **PART 2 - PRODUCTS**

### **2.01 MATERIALS, PRODUCTS, EQUIPMENT, MANUFACTURED UNITS**

A. Fiber Optic Cabling: See Section 271346 Local Area Network Fiber Optic Cabling.

B. Category 6 Horizontal Cable

1. General: Data pairs are to be extended between the outlet location and its associated IDF. The cable is to consist of 4 pair 23 gauge, solid copper conductors, certified to the Category 6 standards. ETL or UL verified for EIA/TIA electrical performance and comply with FCC part 68. Cables are to be terminated on each of the 8-position modular jacks provided at each outlet. Voice is to utilize this same cable type. Only virgin materials are to be used.
  - a) Cable selection is to be based upon meeting an end-to-end channel performance and be shown to have been tested with the proposed component manufacturer's products and warranted as a complete permanent link and channel solution by the connectivity Manufacturer.
  - b) The Cabling System Warranty shall be issued by the connectivity manufacturer. (Jacks, patch panels, patch cords, etc.). A Warranty from the cable manufacturer or the Contractor shall not be accepted.
2. Cable Insulation and Jacket: Cable jacket is to comply with Article 800 of the NEC for the environment in which the cable will be installed. All cables are to bear the UL and NEC, CMR or MPR markings. (All cable is to be RISER rated

unless otherwise specified or required by code). All PLENUM cables are to bear the UL and NEC, CMP or MPP markings.

3. Horizontal cable drops from IDF or MDF to specified outlet locations are to be without splices.
4. Properties: Electrical Characteristics for horizontal cable tested on 100 m length are to be as follows:

	TIA/EIA CAT 6
Frequency	500MHz
Characteristic Impedance	100Ω ±15%
NEXT (dB) Minimum	39.2dB
PSNEXT (dB) Minimum	37.2dB
ELFEXT Minimum	12.3dB
PSELFEXT Minimum	11.3dB
Return Loss Minimum	18dB
Maximum Attenuation (dB/100m)	54.5dB

1. Horizontal Cable Specified: In addition to meeting listed requirements cable is also required to meet a 20 year or greater total PDW warranty. The cable selected must be one of those listed below and be approved cable for use in a warranted system from the connectivity manufacturer.

a) Approved horizontal copper cabling manufacturers:

1. Amp, Belden, Berk-Tek

B. Category 6 Modular Copper Patch Cords

1. Category 6 Modular Copper Patch Cord assemblies shall be constructed using modular plugs with 50µm gold-plated contacts, and shall be wired to the T568A wiring pattern. Cable assemblies shall utilize colored cable and "snagless" cable boots that match the color of the cable.
2. Conductors shall be 24 AWG, 7/32 stranded copper. Insulation shall be Flame Retardant Polyethylene. Jacket shall be PVC (Riser Rated), .210 nominal diameter. Boot shall be Elastomer Polyolefin. Plug Housing shall be Clear Polycarbonate. Terminals shall be Phosphor bronze with 50µm gold plating on selected area, gold flash over the remainder, over 100µm nickel underplate.



3. Provide Category 6 Modular Patch Cords for each patch panel port, 7'-0" length.
4. Provide Additional Category 6 Modular Patch Cords for each work station outlet jack plus an additional 50% of the total workstation outlet jacks (total workstation jacks x 1.5).
5. Twenty-five percent (25%) of all workstation jack patch cords shall be 5'-0" in length. Fifty percent (50%) of all workstation jack patch cords shall be 7'-0" in length. Twenty-five percent (25%) of all workstation jack patch cords shall be 10'-0" in length.
6. All patch cords shall be green in color.

#### C. Copper Tie Cabling

1. Where required copper tie cabling is to be provided between IDF's and MDF. All voice grade wire and cable placed underground is to be solid twisted pair, multi-conductor, ASP-filled core cable. Cable jacket is to be aluminum steel polyethylene (ASP) dual insulated with foam skin and plastic, and surrounded by filling compound. Cable is to be resistant to mechanical damage, lightning damage or damage from wildlife.
2. Multi-pair backbone copper cables are to meet the following specifications:
  - a) Gauge: 24 AWG
  - b) DC Resistance: 27.3Ω/1000 ft (8.96Ω/100m), maximum
  - c) Mutual Capacitance (at 1khz)
  - d) Impedance: 100Ω (25pair)
  - e) Buried/Underground Cable Attenuation (dB/1000 ft [305m]): at 1.0MHz: 6.4 (25 pair), maximum
  - f) Aerial Cable Attenuation (dB/1000 ft [305m]): at 1.0 MHz: 6.7 (25 pair), maximum
3. Design Selection:
  - a) Amp
  - b) Belden
  - c) Berk-Tek

#### D. Site Copper Cable Protection Units

1. Entrance Protection (Analog or Digital Phone Systems): All site copper circuits are to be provided with protection between each building with an entrance cable protector chassis. All building-to-building circuits are to be routed through this protector. Protector is to be connected with a #6 AWG copper bonding conductor between the protector ground lug and the IDF ground point. Each protector chassis is to be provided with 5-pin plug-in protector modules for each pair terminated on the chassis.
  - a) Design Selection:
    1. Porta Systems, #24100-1100-M110C w/1155CN-240 modules (Analog phones), or #1155CN-75 (75 volt) modules for (Digital phones).

2. Or equal by Circa or Systimax.
2. VoIP Entrance Protection (Cisco or other VoIP Phones): All site copper circuits that are intended to distribute voice over IP (VoIP) are to be provided with protection between each building with data rated primary protectors. All copper data grade building-to-building circuits are to be routed through this protector.
  - a) Design Selection:
    1. Porta Systems #606-27 (non-PoE circuits)
    2. Porta Systems #606-65 (for circuits providing PoE power)
3. Portable Classrooms: Site Cat 6 copper circuits from building or portable (modular) IDF's to portables (modular) are to be provided protection on both ends. At the IDF rack, multi-port rack mounted protector patch panels are to be used for the outgoing Cat 6 cable. Cable is to be run in conduit to the portables where they will terminate in 3-port and 4-port Wall Plate protector units directly without splice.
  - a) Design Selection:
    1. CoreTEK Industries, Inc.: CTI-R12, CTI-W3, and CTII-W4 respectively. Requires "Red" CoreTEK protectors.

#### E. Equipment Racks

1. General: Each MTR and ITR is to be equipped with 19 inch EIA rack(s), floor mounted, to house owner-provided equipment and contractor provided termination bays for multiple cable types. Floor mounted racks are to be mounted on an isolation pad and utilize non-conductive washers to secure the rack to the floor. Floor mounted open racks are to be secured from the top rail to the backboard in the room with a length of cable tray to prevent movement. Wall racks are to be securely fastened to the wall studs with at least 1/4" hardware. All racks are to be bonded to the TR ground bar using a standard ground lug and #6 AWG insulated green cable.
2. Equipment Mounting Selections:
  - a) Floor Rack: Panduit # CMR19X84S; or owner approved equal
  - b) Isolation Pad: Chatsworth, Hubbell, B-Line, or Pathways & Spaces, Inc.
3. Rack Accessories: Each equipment rack is to be provided with the following accessories:
  - a) Horizontal Cable Organizer: Premise wiring Organizer, Front/rear 19" rack mount, 2U high, 3.5" tall, w/3.5" deep rings on the front (with cover), and 4.6" deep rings on the rear (no cover).
    1. Panduit #WMPH2E
  - b) Power Plug Strip: 120V, 15 Amp surge protected, 10 outlet, 19 inch rack mounted w/switch and 5-15P plug, 10 foot cord length, steel housing (black).
    1. Panduit #CMRPSH15

4. Cable Routing: Ensure that station cables will be routed into the rear station Cable Manager, neatly organized and terminated onto the patch panel following TIA/EIA-568-B, 569 termination guidelines. Require that a horizontal cable manager be installed above and below any patch panel installed on the rack. Patch panels and front/rear cable manages are to be installed in alternating order on the rack. Also, ensure that on 48 port patch panels, the cables terminated on the top 24 ports is neatly routed through the cable manager mounted above the patch panel and conversely those terminated on the lower 24 ports are routed through the cable manager mounted below the patch panel. This routing method allows easier moves, adds and changes at a later date.
  
5. Vertical Cable Management: Free standing relay racks are to have vertical cable management installed on each side of the rack. If more than one rack is installed then each rack will be separated by a vertical, duct style cable manager. Black, 6” channels with covers.
  - a) Panduit #WMPVHC45E
 

NOTE: This part number provides vertical cable management for one side of the rack only.
  
- F. Plywood Backboards: Backboards are to be installed in each MTR and ITR on all four (4) walls from 12” AFF to a height of 9’-0” AFF. Rooms are to have walls covered with ¾” A/C Grade plywood with the “A” side out. Imperfections and voids are to be filled, sealed and sanded prior to being primed and painted with two coats of UL Classified, fire retardant intumescent paint on the front, back and all four sides of the plywood. Fire retardant coating is to be tested to UL723, “Test for Surface Burning Characteristics of Building Materials”; backboards are to be clearly labeled with the name of the backboard manufacturer, UL Classification of the Fire Retardant Coating, NFPA 255 Coating Flame Spread Index Class and the APA Grade of the plywood.
  
- G. Category 6 Patch Panels
  1. General: Equipment Racks: Provide with 19” rack mount, 8-position modular jacks (RJ45), non-keyed, factory configured, patch panels for termination of all copper horizontal cables.
  2. Work Area Outlet Patch Panels: Test to meet the Category 6 standard for component and channel performance and are to be modular-to-110, wired for T568B pin outs for the cables serving the Work Area Outlets.
    - a) Category 6 patch panel component values:
 

1. NEXT (dB)	at 250 MHz	46.0 dB or exceed
2. Insertion Loss (dB)	at 250 MHz	0.32 dB or less
3. FEXT (dB)	at 250 MHz	35.1 dB or exceed
    - b) Patch panels are to be provided in 24 and 48 port configurations.
      1. Design Selection:

- (a) Panduit #CPP24FMWBLY (24 port); #CPP48FMBLY (48 port)
  - (b) AMP #1116749-1 (24 port); #1375119-1 (48 port)
- 3. Voice Site Patch Panels: Provide for the distribution of the voice pairs to the work area patch panels via patch cords. Terminate the site copper tie cables, 25 or 50 pair, via the protector units to voice patch panels. These patch panes are to be configured with one voice pair per port (blue pair) via the 110-connector side of the panel. The panels are to be configured as 8-positon modular jack-to-110 termination panels in the required quantities.
- 4. Identification: Each jack on all patch panels is to be identified with permanent machine generated labels, meeting the EIA/TIA 606 requirements, matching the Nassau County School District numbering plan as shown (re: para. 2.1.M.6.3.(b)) on the faceplate. All labeling is to be permanent. All labeling is to be 12 point in size. Engineer is to approve labeling prior to fabrication.

#### H. Cable Support System

- 1. General: Horizontal cables are to be suspended by pre-manufactured CAT 6 rated J-hooks and Hilti "ECH" hangers in closets where J-hooks, ladder tray or rack management is not available. All supports are to be permanently attached to the structure using all-thread suspension, beam clamps, or wall mount to the structural metal or wooden members. The J-hooks are to feature a wide base loop with smooth curves to eliminate snag potential and cable deformation.
- 2. Use of cable ties within the Telecommunications room is strictly prohibited. Velcro cable ties or Velcro wraps are to be used instead of cable ties in all rooms where Category 6 cable and fiber optic cable is terminated. Including all Data Centers, MC's (MDF), TC's or IDF's.
- 3. J-hooks are to be in accordance with the NEC, EIA/TIA requirements for structured cabling systems. All cable supports are to be UL listed.
  - a) Design Selection:
    - 1. Erico Caddy
    - 2. Generic J-hook
- 4. Ladder Rack: Ladder Rack for equipment rack tie to wall is to be 12 inches wide with a 6 inch rung spacing, have a minimum of 24 square inches of cable pathway and minimum 24 inch radius. Adjustable splice connectors are acceptable where needed to accommodate non-standard vertical and horizontal bends. Each straight section, and fitting, is to be provided with two "heavy duty" splice connectors and appurtenant hardware. The splice, when bolted together to form a tray joint, is to be designed to have the same strength (or better) than the tray when placed mid-span. The tray system is to be capable of carrying 50 lb/linear foot without exceeding a 1.5 inch mid-span deflection (in accordance with NEMA Class 8A) when supported every 4 foot. Support the tray system from wall studs or suspend from the structure above the ceiling, do not suspend the tray system from the roof deck.

- a) Design Selection: Ladder Tray manufacturer is to be Chatsworth Products, Inc. Cable Runway<sup>®</sup> and Raddii Bends<sup>®</sup> or owner approved equal.

#### I. Outlets

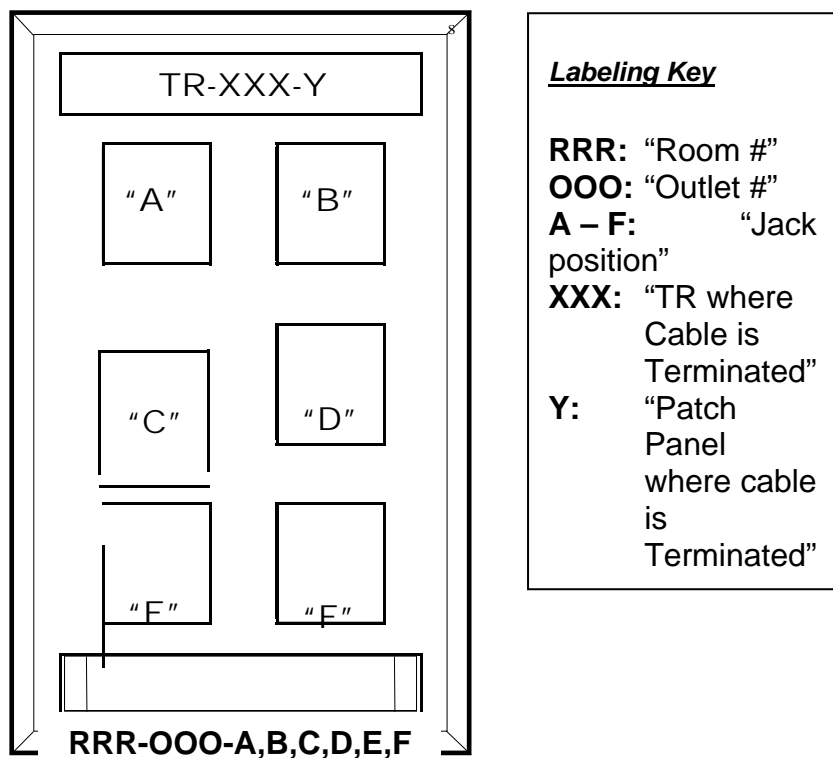
1. General: Communications outlets that contain copper services are to be equipped with ANSI/TIA/EIA-568-B.2-1 Category 6, 8-position modular jacks (RJ45 type) utilizing T568B wiring. Terminate all outlet cabling on appropriate termination blocks at their associated IDF. Outlets are to be certified to operate at 1000 Mbps data speed with twisted pair horizontal cabling as verified by ETL or UL. Faceplates are to be able to accommodate up to 6, 8-position modular jacks each.
2. Wall Outlets: Wall outlets are to consist of single gang wall plates with blank module inserts for all unused module locations.
3. Modular Furniture Outlets: Furniture outlets are to consist of a modular furniture faceplate capable of housing up to four (4) 8-position modular connectors with blank module inserts for all unused module locations.
4. House Wall Phone: Wall phone outlets are to consist of a SE630 type wall plate with Category 6 minimum cable to each, terminating in an 8-position modular jack.

#### J. Outlet Placement:

1. Standard PDS Wall Plate locations shall be installed where shown on the project drawings.
2. Wireless LAN - (WAP) Wall Plates shall be as follows:
  - a) Classroom Placement: Ceiling mount, one (1) per classroom. The outlet shall be located on the ceiling close to the center of the room. Mounting of the low voltage faceplate shall comply with all applicable codes and standards.
  - b) Common Area Placement: (locations such as the Cafeteria, Library, Study Halls, etc.). Shall be designed to for higher density usage of the WLAN system. All areas designated as "WLAN Common Areas," shall have WAP Wall plates located on each wall (one per wall minimum). For larger rooms, the WAP wall plates shall be located no more than 10' to 12' from the floor.
  - c) Administration Area: (Areas such as the Teachers' Dining Room, Reception Area, etc.) one (1) outlet shall be wall mounted, between 10' to 12' high from the finished floor.
  - d) All WAP wall plates shall be compliant with IEEE 802.3af, PoE power for Data Terminal Equipment (DTE).
  - e) All WAP wall plates shall utilize the same wall boxes and conduit stub-up installation as standard PDS wall plates.
3. 8-position Modular Jack: Category 6 jacks are to meet or exceed the following electrical and mechanical specifications:
  - a) Electrical Specifications:

1. Insulation Resistance: 500 M minimum.
  2. Dielectric withstand voltage 1000 VAC RMS, 60 Hz minimum, contact-to-contact and 1500 VAC RMS, 60 Hz minimum from any contact to exposed conductive surface.
  3. Contact Resistance: 20 m maximum.
  4. Current Rating: 1.5 A at 68 F (20 C) per IEC Publication 512-3, Test 5b.
5. ISO 9001 Certified Manufacturer.
  6. UL Verified for EIA/TIA electrical performance.
  7. Comply with FCC Part 68.
- b) Mechanical Performance:
1. Plug Insertion Life: 750 insertions
  2. Contact Force: 3.5 oz (99.2 g) minimum using FCC Approved modular plug.
  3. Plug Retention Force: 30 lb (133 N) minimum between modular plug and jack.
  4. Temperature Range: -40 °F to 150 °F (-40 °C to 66 °C).
4. Channel Performance: All Enhanced Category 6 jacks are to be utilized in a channel configuration meeting or exceeding the following specifications at 250 MHz:
- a) NEXT (dB) at 250 MHz 46.0 dB or exceed
  - b) Insertion Loss (dB) at 250 MHz 0.32 dB or less
  - c) FEXT (dB) at 250 MHz 35.1 dB or exceed
  - d) Return Loss (dB) at 250 MHz 16.0 dB or exceed
5. WLAN faceplates for Wireless Access Points (WAP) locations.
- a) Wall Faceplate (office white)
  - b) Data and Voice Jacks (blue): Panduit # CJ6E88TGBU; AMP # 1375187-6
6. Standard PDS Wall Plate Design Selection: these wall plates are to be located throughout each classroom or office location.
1. Wall Faceplate (office white) w/sloped modules: Panduit # CFPSE4EIY; AMP # [1339118-X](#)
  2. PDS Jacks (yellow): Panduit # CJ6E88TGYL; AMP # 1375187-8
  3. Miscellaneous Building Systems, security, fire, A/V, and BMS/EMS (white): Panduit # CJ6X88TGIW; AMP # 1375055-3
  4. Voice (green): Panduit # CJ6E88TGGR; AMP # 1375187-9

5. Blanks (office white)
  - (a) Provide blank module inserts for all unused module locations.
  - (b) Outlet Labeling: Each jack on all outlets is to be identified with permanent machine generated labels, meeting the EIA/TIA 606 requirements, matching the Nassau County School District numbering plan on the faceplate. All labeling is to be permanent. All labeling is to be 12 point in size. Engineer is to approve labeling prior to fabrication.
  - (c) Example labeling



K. Unspecified Equipment and Materials

1. Ensure that the Contractor understands that any item of equipment or material not specifically addressed on the contract drawings and required to provide a complete and functional SCS installation is to be provided at a level of quality consistent with other specified items.

L. Grounding System and Conductors

1. Communications bonding and grounding is to be in accordance with the National Electrical Code (NEC) and NFPA as well as EIA/TIA grounding and bonding standards. Backbone and entrance cables are to be grounded in compliance with ANSI/NFPA 70 and local requirements and practices.
2. A #6 AWG stranded copper wire cable is to be extended between new ground bars located at each IDF and the building main electrical service ground point or secondary transformer ground point. The building steel, the equipment racks, and all surge suppressors, Protectors and metallic cabinets are to be bonded to the ground bar via a #6 AWG stranded copper cable and UL approved connecting hardware.

**PART 3 - EXECUTION**

3.01 INSTALLATION STANDARDS AND TOLERANCES

- A. General: Cable routing and Installation practices shall be in accordance with BICSI's Telecommunications Distribution Methods Manual (TDMM) and Telecommunications Installation Manual.
- B. T568B wiring pin out configuration is to be used for all jack and patch panel terminations. T568B is to be the standard for all twisted pair wiring.
- C. All cable runs are to contain a service slack prior to the termination point. Provide for a 12-inch service slack in the ceiling above each outlet. Service slack at IDF is to consist of a 10-foot slack section for all station cables located and placed neatly in the cable ladder above the equipment rack.
- D. Plenum Spaces and cable routing: The majority of PDW wiring is installed above ceilings. All communications cabling used throughout is to meet the requirements as outlined in the National Electrical Code (NEC) article 800. In ducted "air return" applications, and cable run in conduit the cable is to bear CMR, MPR or OFNR (RISER) and/or appropriate marking. In non-ducted return air applications or as required by local and/or state code requirements cable is to bear CMP, MPP or OFNP (plenum) markings. Verify with state and local code enforcement officers where plenum and non-plenum cables are required. All cables are to bear the appropriate markings of the environment in which they are installed.
- E. Cable Pathways:
  1. Above ceilings:
    - a) All primary cable pathways Utilize J-Hooks.
    - b) Use of ceiling tiles, grid or hanger wires for the support of PDW cables is to be prohibited.
    - c) Horizontal cables used in the system are to be installed within the ceiling spaces. Cables routed in these spaces are to be at right angles to electrical power circuits and supported only from the structure. Tie cables between MDF and IDF's are to utilize conduit.



#### F. Category 6 Cable

1. Provide for Category 6 UTP cables are installed in accordance with EIA/TIA guidelines for Category 6. Contractor will replace cable installation and terminations that do not comply.
  - a) Maximum pulling tension is not to exceed 25 pounds.
  - b) Minimum bending radius of the cable is not to be less than 4 times the diameter of the cable.
  - c) The cable is to be installed without kinks or twists and the application of cable ties is not to deform the cable bundle.
  - d) Require the Contractor to only strip back only as much cable jacket as required to terminate the cable and the amount of untwisting in a pair as a result of the termination is not to exceed 0.5 inch.

G. In suspended ceiling and raised floor areas where duct, cable trays, or conduits are not available, bundle Category 6 cables in bundles of 40 or less, horizontal wiring above the ceiling is to be secured with cable ties, the cable ties are to be installed loosely. Cables are to be loose enough to be rotated easily by hand. Cable ties used in plenum areas are to be plenum rated. Ensure ties are not tightened to a point where they will deform the cable geometry.

H. Provide a minimum of two hangers at any corners or 90 degree turns. Attachment shall be to the building structure and framework at a maximum of five (5) foot intervals. Ceiling suspension wire or independent tie wires are not to be allowed for cable support. Where cable is routed above the ceiling in areas where there are no walls, all-thread is to be used (minimum 1/4", however sized to support the intended weight) with the appropriate CAT 6 hanger for cross-room support. Support rods are to be level and plumb after cable installation. Manufacturers' requirements for bending radius and pulling tension of all cables are to be adhered to.

I. Fire Stopping Protection: All fire stopping of openings through rated fire and smoke walls existing or created by the premise wiring contractor are to be sealed under Division 7 Section Firestopping.

J. Damage: Repair of surfaces including painting and ceiling tile replacement is to be the responsibility of the premise wiring contractor.

K. Avoiding EMI: To avoid EMI provide clearances of at least four (4) feet (1.2 meters) from motors or transformers; 1 foot (12 inches) from conduit and cables used for electrical power distribution; and 1 foot (12 inches) from fluorescent lighting. Pathways are to cross fluorescent lighting and electrical power cables and conduit perpendicularly.

#### L. Work External to the Building

1. General: The same requirements are to apply to exterior installations as do those within the confines of the building, with code required adjustments.

### 3.02 FIELD QUALITY CONTROL

#### A. Field Testing:

## 1. Testing of Wiring Accuracy

- a) Ensure the Premise Distribution Cabling Contractor tests wiring setting tester for channel configuration which includes the patch cord, patch panel, UTP Cable, work-area jack and work-area cord.
- b) Testing Equipment: Agilent Technologies, Fluke, Microtest or Ideal are approved manufacturers of test equipment. Testers are to be 100% Level III compliant with TIA/EIS 568.2-1 specifications for testing of CAT 6 cabling. No testers will be approved without meeting these requirements.
- c) Testing Guidelines: Each jack in each outlet is to be tested at a minimum of Category 6 compliance. Tests are to be done in a LINK configuration to verify the integrity of all conductors and correctness of the termination sequence. The manufacturer is to provide 100% factory testing of the patch cords. It is not acceptable practice for patch cords to be unpackaged for use in certification testing. The cords shall remain boxed and stored for installation by the owner or as otherwise indicated by the scope of work. Perform testing between the outlets and the patch panel at the equipment rack, prior to testing UTP runs the tester shall be calibrated per manufacturer's guidelines. The correct cable NVP shall be entered into the tester to assure proper length and attenuation readings.
- d) The Contractor must verify that this testing method is acceptable to the manufacturer that will be providing the LINK AND CHANNEL warranty for the project.
  - 1) 250 MHz sweep tests, Wire map, Attenuation, NEXT, PSNEXT, ELFEXT, PSELFEXT, ACR, PSACR, Return Loss, Delay, Delay Skew, and the installed length for Category 6 cables.
  - 2) Cables not complying with ANSI.TIA.EIA-568-B.1 and B.2-1 Category 6 tests are to be identified to the engineer for corrective action which may include replacement at no additional expense to the Owner.
  - 3) Documentation of cable testing is required.

## 2. Testing of Fiber Optic Cable

- a) Provide that each strand in fiber optic cables is tested for correctness of termination, overall transmission loss, and defects using an approved Optical Time Domain Reflectometer (OTDR) and a power meter. The Engineer, with one week prior notice, is to be present for all tests.
- b) Testing Equipment: Agilent Technologies, Fluke, Microtest, Noyes or Ideal are acceptable manufacturers of test equipment.
- c) Testing of multimode fiber is to be in accordance with TIA/EIA-526-14 method B. System loss measurements (both calculated and measured) are to be provided at 850 and 1300 nanometers in both directions for multimode cables (1310 and 1550 nanometers for single-mode) for each strand. Per IEEE 802.3z, maximum fiber strand attenuation is not to exceed 2.38 dB @ 850 nm

with a modal bandwidth of 160 MHz/km and 2.35 dB @ 1310 nm with a modal bandwidth of 500 MHz/km. Test as follows:

- dB/km.
- 1) Measure and record normalized fiber loss at operating wavelength in
  - 2) Detect and record point faults or discontinuities.
  - 3) Measure and record overall length of cable.
- d) Certification report is to be provided listing both the calculated and measured loss for each fiber optic circuit and submitted with the test results as called for above.
- 1) Wavelength, fiber type, fiber manufacturer and cable model number, cable manufacturer's attenuation specifications, cable manufacturers' bandwidth specifications, measurement direction, test equipment and serial numbers (with last date of calibration), date of each test, reference setup, name of technician(s) performing testing.
  - 2) OTDR trace(s) is to be submitted with request for substantial
- completion

### 3.03 DEMONSTRATION

- A. Provide one 2-hour training session to familiarize the owner with the locations of all IDF's, cable and jack labeling and number systems, data and voice connections.

END OF SECTION 271348

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## SECTION 27 51 15

### INTERCOM, PUBLIC ADDRESS AND MUSIC SYSTEM

#### PART 1 GENERAL

##### 1.01 WORK INCLUDES

- A. Expansion of the existing Rauland Borg intercom system and public address system to accommodate the new construction at Building 11. Include all classroom speakers, call in buttons, head-in equipment, raceways, outlet boxes and conductors. Connect all new devices and wiring to existing system in Building 11. Provide expansion modules as required.

##### 1.02 REFERENCES

- A. NFPA 70 - National Electrical Code.

##### 1.03 SYSTEM DESCRIPTION

- A. The equipment specified herein shall as a system provide a modular communications system capable of two way communications between classrooms and the main office with public address or all call capability, music playback, and bell scheduling.

##### 1.04 SUBMITTALS

- A. Submit under provisions of Section 26 03 05.
- B. Shop Drawings: Indicate electrical characteristics and connection requirements. Indicate layout of equipment mounted in racks and cabinets, component interconnecting wiring, and wiring diagrams of field wiring to speakers and remote input devices.
- C. Product Data: Provide showing electrical characteristics and connection requirements for each component. Include data for the following:
  - 1. Classroom Speakers.
  - 2. Exterior Horn Speakers.
  - 3. Call Buttons.
  - 4. Wire and Cable.
- D. Test Reports: Indicate satisfactory completion of each test recommended by the manufacturer.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for

storage, handling, protection, examination, preparation, installation, and starting of Product.

- F. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

#### 1.05 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 26 03 05.
- B. Record actual locations of speakers, control equipment, and outlets for input/output connectors.

#### 1.06 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 26 03 05.
- B. Operation Data: Include instructions for adjusting, operating, and extending the system.
- C. Maintenance Data: Include repair procedures and spare parts documentation.

#### 1.07 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years experience, and with service facilities within a 2 hour response time of project.
- B. Supplier: Authorized distributor of specified manufacturer with minimum three years experience.
- C. Installer: Authorized installer of specified manufacturer with service facilities within a 2 hour response time of Project.

#### 1.08 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish Products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.
- C. Conform to requirements of Federal Communications Commission.

#### 1.09 MAINTENANCE SERVICE

- A. Furnish service and maintenance of public address and music system for three

years from Date of Final Acceptance.

#### 1.10 WARRANTY

- A. The Contractor shall warrant the equipment to be new and free from defects in material and workmanship and will, within three years from Date of Final Acceptance, repair or replace all or any part of the equipment found to be defective. Damage by lightning shall be included in the warranty. This warranty shall not apply if damage is caused by abuse, accident, improper operation, or negligence. Warranty maintenance shall be provided by the Contractor during his normal working hours at no expense to the Owner.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURER

- A. All bids shall be based on the equipment as specified herein. The catalog numbers and model designations are that of the Rauland Borg Corporation. Any substitutions shall be approved by the Architect/Engineer prior to bid.
- B. Bidders wishing to submit alternate equipment shall submit to the specifying authority, at least 15 days prior to bid opening, the equipment proposed to provide a precise functional equivalent system to meet specifications. Bidder shall provide adequate information prior to bid date such as specification sheets, working drawings, shop drawings, and a demonstration of the system. The bidder shall also provide the FCC registration number of the proposed system. Alternate supplier-contractor must also provide a list to include six installations of the identical system proposed which have been in operation for a period of two years.

#### 2.02 INTERCOM COMPONENTS

- A. The existing school intercom system is a Rauland Borg TCVI TC700 system located in Building 01 with auxiliary equipment located in Building 11.
- B. Each classroom and other designated room shall be provided with a room loudspeaker, and a room station call-in button.
- C. Eight (8) inch loudspeakers shall be provided in each classroom, teacher planning area and in hallways as designated on plans.
- D. Call-in button shall be provided in each location below the loudspeaker.

#### 2.03 LOUDSPEAKER

- A. Classroom loudspeaker shall be Rauland Model ACC1400 type, with ACC1101 Back can and ACC1104 T-bar support or approved equal. The speaker shall be

eight inch, seamless cone with ceramic magnet. Magnet shall weigh at least 10.0 ounces. The frequency range shall be from 30 to 20,000 Hz. The normal wattage rating shall be 15 watts with a program rating of 25 watts. The voice coil diameter shall be 3/4" and the impedance 8 ohms. The loudspeaker shall be equipped with a universal matching transformer suitable for use on a 25-volt output line with taps at 1/2, 1, 2 or 4 watts. The loudspeaker shall be housed in a recessed enclosure with flush metal baffle.

- B. Weather-proof horn speaker shall be provided around the outside of the building and as designated on plans. Speakers shall be wide dispersion indoor/outdoor horn with driver. Power rating shall be 30 watts. Low frequency cutoff shall be 250 hz. Sound distribution shall be 20 x 50 degrees. Minimum sound pressure level shall be 120 dB at 4 feet with full range input. Material shall be cast aluminum.

#### 2.04 CALL BUTTON

- A. The Call Origination Switch shall be a Rauland Model 2305CS or approved equal. It shall be of the momentary contact pushbutton type and shall be fully enclosed. The switch contacts shall be of the self-wiping type with precious metal contact surfaces. It shall be mounted on a single-gang stainless steel wall plate.

#### 2.05 MATCHING TRANSFORMERS

- A. Description: Tapped at 1/2, 1 and 2 watts with primary/secondary ratio to match amplifier to speaker impedances.

#### 2.06 VOLUME PADS

- A. Description: Transformer type rated 10 watts.

#### 2.07 WIRE AND CABLE

- A. Interior intercom cable: 4 conductor, 22 AWG tinned stranded copper conductors. 2 conductors shall be twisted pairs with a foil shield and 24 AWG drain wire for connection to the speakers. 2 conductors shall be unshielded for connection to the call-back switch. Conductor insulation shall be 300 volt PVC with an overall PVC jacket rated at 75° C. West Penn No. 355 or equal.
- B. Speaker cable shall be a UL listed 18 AWG solid copper conductor with PVC insulation. Each cable shall be a twisted pair with an overall PVC jacket. The cable shall be West Penn 228 or equal.

#### 2.08 TERMINAL BLOCKS

- A. M66 insulation displacement type terminals.



## 2.09 TERMINAL BLOCK ENCLOSURES

- A. NEMA 250, Type 1 steel enclosure.
- B. Continuous hinge cover with flush latch and key lock.
- C. Interior metal panel, for terminal block mounting, painted with white enamel.
- D. Enclosure finish: Manufacturer's standard gray enamel.
- E. Minimum size: 12"W x 18"H x 6"D.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Mounting Heights: Coordinate locations of outlet boxes specified in Section 26 05 33 to obtain mounting heights indicated.
- C. Wall-mounted Speaker: 7 feet above finished floor.
- D. Call-in Switches: 4 feet above finished floor.
- E. Terminal Block Enclosures: 5 feet - 6 inches above finished floor to top of cabinet.
- F. Splice all cable only at terminal block enclosures and end use equipment. Do not splice conductors.
- G. Make cable shields continuous at splices and connect speaker circuit shield to equipment ground only at amplifier.
- H. Install input circuits in separate cables and raceways from output circuits.
- I. Leave 18 inches excess cable at each termination at microphone, volume pad, speaker, and other system outlet.
- J. Leave 6 feet excess cable at each termination at system cabinet
- K. Provide protection for exposed cables where subject to damage.
- L. Connect reproducers to amplifier with matching transformers.

- M. Install equipment racks in location shown; arrange to provide adequate ventilation and access.
- N. Ground and bond equipment and circuits in accordance with Section 26 05 26.
- O. Install all wiring in conduit. Conduit shall be adequate size for cables installed therein.
- P. Install antenna on roof where not visible from ground level with building height from building wall.

### 3.02 ADJUSTING

- A. Adjust transformer taps for appropriate sound level.
- B. Adjust devices and wall plates to be flush and level.

### 3.03 TESTING

- A. Upon completion of the installation, the system must be tested by the manufacturer's representative and all necessary modifications and/or adjustments must be made to assure compliance with this specification.

### 3.04 SURGE SUPPRESSION

- A. Provide transient voltage surge suppression protection according to Section 26 35 55, "Transient Voltage Surge Suppression" on all TV cables between buildings and at all buildings.

### 3.05 DEMONSTRATION

- A. Conduct walking tour of Project. Briefly describe function, operation, and maintenance of each component.
- B. Use submitted operation and maintenance manual as reference during demonstration.

END OF SECTION

SECTION 28 31 00

FIRE ALARM AND SMOKE DETECTION SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire alarm and smoke detection systems.

1.02 WORK INCLUDES

- A. Section includes fire alarm system component replacement with new, addressable system equipment, including but not limited to fire alarm voice evacuation panel, fire alarm terminal cabinets, manual fire alarm stations, automatic smoke and heat detectors, fire alarm signaling appliances, fire alarm speakers, strobes, combination devices and auxiliary fire alarm equipment and power and signal wire and cable.

1.03 REFERENCES

- A. NFPA 72 - 2014 National Fire Alarm Code.
- B. NFPA 101 - 2017 Life Safety Code.
- C. Florida Fire Prevention Code - 2017 edition.

1.04 REGULATORY REQUIREMENTS

- A. System: UL and FM listed.
- B. Conform to requirements of NFPA 101.

1.05 SYSTEM DESCRIPTION

- A. Provide a new Silent Knight model SKE-450 voice evacuation fire alarm control system in the school cafeteria Building 08, with all new devices and wiring to replace existing.
- B. All new equipment and materials shall be compatible with the existing Silent Knight fire alarm system located in the school main office, Building 02.
- C. Fire Alarm System: NFPA 72, manual and automatic local fire alarm system.
- D. Alarm Sequence of Operation: Actuation of initiating device causes the following system operations:
  - 1. Local fire alarm signaling devices sound and display signal.
  - 2. Location of alarm device indicates on fire alarm control panel.

3. Signal transmits to building mechanical controls, shutting down fans and operating dampers.
- E. Drill Sequence of Operation: Manual drill function causes alarm mode sequence of operation.
- F. Trouble Sequence of Operation: System or circuit trouble causes the following system operations:
  1. Visual and audible trouble alarm indicates by device at fire alarm control panel.

#### 1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in smoke detection and fire alarm systems with five years documented experience.
- B. Installer: Company specializing in smoke detection and fire alarm systems with 2 years documented experience, certified as fire alarm installing contractor.

#### 1.07 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 26 03 05.
- B. Provide wiring diagrams, data sheets, and equipment ratings, layout, dimensions, and finishes.
- C. Submit manufacturer's installation instructions under provisions of Section 26 03 05.
- D. Submit manufacturer's certificate under provisions of Section 26 03 05, that system meets or exceeds specified requirements.

#### 1.08 OPERATION AND MAINTENANCE DATA

- A. Submit data under provisions of Section 26 03 05.
- B. Include operating instructions, and maintenance and repair procedures.
- C. Include manufacturer representative's letter stating that system is operational.

#### 1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site and store and protect products from adverse weather.

#### 1.10 EXTRA MATERIALS

- A. Provide the following spare parts:
- B. Provide two keys of each type.

## 1.11 WARRANTY

- A. The Contractor shall warrant the equipment to be new and free from defects in material and workmanship and will, within five years from Date of Final Acceptance, repair or replace all or any part of the equipment found to be defective. Damage by lightning shall be included in the warranty. This warranty shall not apply if damage is caused by abuse, accident, improper operation, or negligence. Warranty maintenance shall be provided by the Contractor during his normal working hours at no expense to the Owner.
- B. Provide manufacturer's warranty and authorized preventative maintenance services for a period of three years from the date of Final Acceptance. Warranty shall include full replacement cost including material and labor required to replace any component of the fire alarm systems.

## 1.12 TRAINING

- A. Provide 16 hours of training in multiple sessions, each not to exceed 8 hours in length.
- B. Use approved shop drawings and operation and maintenance data to detail normal and emergency operation and repair procedures.

## PART 2 PRODUCTS

### 2.01 FIRE ALARM AND SMOKE DETECTION CONTROL PANEL

- A. The existing fire alarm control panel (FACP) is a Silent Knight model 5820XL analog addressable control panel. Substitution of the panel from a different manufacturer shall not be allowed.

### 2.02 FIRE ALARM VOICE EVACUATION PANEL

- A. The fire alarm voice evacuation panel (FAVP) unit shall be a Silent Knight model SKE-450 system. Substitution of the panel from a different manufacturer shall not be allowed.
- B. The voice annunciation unit shall provide 25 watts signal power and 25 watts voice power, and shall be UL listed.
- C. The voice annunciation unit shall be micro-processor based, and shall contain an integral microphone, 25-watt audio amplifier, tone generator, digital message repeater, 120 VAC power supply and battery charger.

- D. The voice annunciation message/signal shall be broadcast until the Fire Alarm Control Panel (FACP) is reset, or until fire emergency personnel interrupt the broadcast with a manual page. On reset system shall automatically return to standby (normal operating) condition.
- E. A secondary message shall be provided which can be triggered by the closure of a contact from either the FACP or from any normally open contact device.
- F. Remote paging microphone(s) will be supported by the system through a supervised circuit. Remote microphone(s) may be mounted up to 5000 feet from the voice annunciation panel.

### 2.03 FIRE ALARM EXPANDER PANEL

- A. The fire alarm expander panel (FAEP) shall be a Silent Knight model 5895XL intelligent power module. Provide panel where required to add devices to the fire alarm system.
- B. The contractor shall supply a power module compatible with the IntelliKnight Model 5820XL FACP. The power module must have 6.0 amps of output power, Flexput I/O circuits rated 3.0 amps each, and two Form C relay contacts rated at 2.5 amps at 24 VDC. The power module shall connect to the main FACP via an RS-485 system bus (SBUS). The power module shall contain an additional RS-485 bus that is completely compatible with all IntelliKnight add-on modules, including 5815XL SLC expander's, 5860 remote annunciators, 5824 serial/parallel printer interface modules.
- C. The power module RS-485 bus shall be optically isolated providing ground loop isolation and transient protection. The unit shall be an SBUS repeater that conditions the signal driving up to 6,000 feet of additional

### 2.04 FIRE ALARM TERMINAL CABINET

- A. Fire alarm terminal cabinets shall house expansion modules for signal line circuits and power modules for notification circuits.
- B. The system cabinet shall be red and can be either surface or flush mounted. The cabinet door shall be easily removable to facilitate installation and service.
- C. An audible system trouble sounder shall be an integral part of the control unit. Provisions shall also be provided for an optional supervised remote trouble signal.
- D. The terminal cabinet shall operate on 24 VDC, filtered switch mode power supply with the rated current available of 5 Amps. The FACP must have a battery charging circuit capable of complying with the following requirements:

1. Sixty (60) hours of battery standby with five (5) minutes of alarm signaling at the end of this sixty (60) hour period (as required per NFPA 72 remote station signaling requirements) using rechargeable batteries with automatic charger to maintain standby gel-cell batteries in a fully charged condition.

## 2.05 System Wiring

- A. The SLC and Data Communication Bus shall be wired with standard NEC 760 compliant wiring, no twisted, shielded or mid capacitance wiring is required for standard installations. All FATC screw terminals shall be capable of accepting 14-18 AWG wire.
- B. Signaling Line Circuits: Each SLC shall be capable of a wiring distance of 10,000 feet from the SLC driver module and be capable of supporting 127 devices. The communication protocol to SLC devices must be digital. Any SLC loop device, which goes into alarm, must interrupt the polling cycle for priority response from the FACP. The FACP must respond consistently to a device that goes into alarm on an SLC in under 3 seconds. The auxiliary 5815XL SLC loop module must be capable of being located up to 6000 feet from the FACP on an RS-485 bus, which is separate from the SLC bus. The SLC shall be capable of functioning in a class A or class B configuration.
- C. SLC loop devices: Devices supported must include analog photoelectric, ionization smoke detectors, analog heat detectors, contact monitoring modules and relay output modules. There is to be no limit to the number of any particular device type up to the maximum of 127 that can be connected to the SLC.

## 2.06 ADDRESSABLE INITIATING DEVICES

- A. Addressable Pull Station: Provide manual stations as shown. Stations shall be red, single action, of the non coded type with terminals and contain a key reset switch for positive resetting action and shall be available with an optional break glass rod. The manual station shall be used with the Addressable Monitor Module. The manual station shall mount to a standard single gang switch box or on an optional red surface mount box.
  1. Manual Stations shall be installed in conjunction with an Addressable Input Module. Manual Stations shall be Silent Knight Models SD500-PS (MIM included) and Underwriters Laboratories listed.
- B. Smoke Detectors & Accessories
  1. Addressable detector functions: The products of combustion detectors must communicate analog values using a digital protocol to the control panel for the following functions:
    - a) Automatic compliance with NFPA 72 standards for detector sensitivity testing
    - b) Drift compensation to assure detector is operating correctly

- c) Maintenance alert when a detector nears the trouble condition
- d) Trouble alert when a detector is out of tolerance
- e) Alert control panel of analog values that indicate fire.

C. Smoke Detector - Photoelectric

1. Provide analog/addressable photoelectric smoke detectors at the locations shown on the drawings. Detectors shall be the Silent Knight Model SD505-APS Addressable Photoelectric Smoke Detector. The base shall be the Silent Knight model SD505-6AB. The Smoke detector shall have a flashing status LED for visual supervision. When the detector is actuated, the flashing LED will latch on steady at full brilliance. The sensitivity of the detector shall be capable of being measured by the control panel without the need for external test apparatus. The detector shall be a double EE-prom technology and be programmed using the internal programming loop located on the FACP.

D. Duct Detector - All Duct Detectors shall be Silent Knight Model SD505-ADH housings with the Model SD505-APS detector.

E. Remote Indicator/Test Switch - Provide remote indicator/test switches for all smoke detectors, (ceiling and duct) where required by code. Indicators may not be shown on plans. Indicator module shall have separate LEDs that indicate normal or alarm condition. Module shall have a momentary key switch for testing of the duct detector. Module shall be Silent Knight Model SD505-DTS.

F. Heat Detectors - Heat detectors shall be Silent Knight Model SD505-AHS (heat) detector.

## 2.07 GENERAL NOTIFICATION APPLIANCES

A. All appliances shall be U.L. Listed for Fire Protective Service.

B. All strobe appliances or combination appliances with strobes shall be capable of providing the "Equivalent Facilitation" which is allowed under the Americans with Disabilities Act Accessibilities Guidelines (ADA(AG)), and shall be UL 1971, UL 1638, and ULC S526 Listed.

C. Furnish and install where shown on the plans:

1. Strobes shall provide 75 cd or 110 cd synchronized flash output. cd shall be based on room size per NFPA.
2. Speakers:
  - a) Low Profile Speaker: Provide low profile wall mount speakers at the locations shown on the drawings. The low profile speaker shall not extend more than 1" (2.5cm) past the finished wall surface, and provide a switch selectable audible output of 2W (90dBA), 1W (87dBA), 1/2W (84dBA), or 1/4W (81dBA) at 10 ft. when measured in reverberation room per UL-464.



- b) Wattage setting shall be visible with the cover installed. When the cover is installed, no mounting hardware shall be visible. In and out screw terminals shall be provided for all wiring. The low profile speaker shall mount in a North American 4" x 2 1/8" square electrical box, without trims or extension rings.
3. Speaker-Strobes:
- a) Low Profile Speaker-Strobe: Provide low profile wall mount speaker/strobes at the locations shown on the drawings. The low profile speaker/strobe shall not extend more than 1" (2.5cm) past the finished wall surface, and provide a switch selectable audible output of 2W (90dBA), 1W (87dBA), 1/2W (84dBA), or 1/4W (81dBA) at 10 ft. when measured in reverberation room per UL-464.
  - b) Strobes shall provide synchronized flash output, that shall be switch selectable for output values of 75cd & 110cd. Wattage and candela settings shall be visible with the cover installed. When the cover is installed, no mounting hardware shall be visible. In and out screw terminals shall be provided for all wiring. The low profile speaker/strobes shall mount in a North American 4" x 2 1/8" square electrical box, without trims or extension rings.
4. Other devices:
- Provide other fire alarm devices including horns, strobes and combination horn/strobes to match existing fire devices in use at the school areas that are not assembly areas.

## 2.08 FIRE ALARM WIRE AND CABLE

- A. Fire Alarm Power Branch Circuits: Building wire as specified in Section 26 05 19.
- B. Initiating Device and Indicating Appliance Circuits: Non-power limited fire-protective signaling cable, copper conductor, 150 volt insulation rated 60 degrees C, 18 AWG pairs.

## 2.09 ELECTROMAGNETIC DOOR HOLDERS

- A. Electromagnetic Door Holders shall be constructed of durable die-cast metal finished in high luster chrome. The electromagnetic door holders shall include dual voltage AC or DC inputs of 24 & 120volts and low current draw of 0.020 mA at 24VDC. Units shall be surface mount with wall mounted back box. Units shall have available options for extensions and misalignment rods. Door holders shall have minimum holding force of 35 pounds and low residual magnetism. Door Holders shall be compatible with Fire Alarm Control Panel. Door Holders shall be UL listed.
- B. Mount door holders at top of doors and at the distance from the strike side of the door as recommended by the door manufacturer.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Provide and install the system in accordance with the plans and specifications, all applicable codes and the manufacturer's recommendations. All wiring shall be installed in strict compliance with all the provisions of NEC - Article 760 A and C, Power-Limited Fire Protective Signaling Circuits or if required may be reclassified as non-power limited and wired in accordance with NEC - Article 760 A and B. Upon completion, the Contractor shall so certify in writing to the Owner and General Contractor. All junction boxes shall be sprayed red and labeled "Fire Alarm". Wiring color code shall be maintained throughout the installation.
- B. Fire Alarm Voice Evacuation Control Panel and Fire Alarm Terminal Cabinet and Fire Alarm Power Supply shall be mounted with the center of panel 60 inches above floor level.
- C. The Fire Alarm Voice Evacuation Control Panel and Fire Alarm Terminal Cabinet shall be connected to a separate, dedicated branch circuit, maximum 20 amperes. This circuit shall be labeled at the Main Power Distribution Panel as FIRE ALARM. Fire Alarm Control Panel Primary Power wiring shall be 12 AWG. The Control Panel Cabinet shall be grounded securely to either a cold water pipe or grounding rod. Conduit shall enter into the Fire Alarm Control Panel back box only at those areas of the back box which have factory conduit knockouts.
- D. Installation of equipment and devices that pertain to other work in the Contract shall be closely coordinated with the appropriate subcontractors.
- E. The Contractor shall clean all dirt and debris from the inside and the outside of the fire alarm equipment after completion of the installation.
- F. The manufacturer's authorized representative shall provide on site supervision of installation.
- G. Install manual station with operating handle 48 inches above floor. Install audible and visual signal devices 80 inches above floor except where lockers, bookcases or other furniture will obscure device. Raise devices to 12" above obstruction where necessary.
- H. Install all fire alarm wiring in conduit.
- I. Cable shall be the type listed for Fire Alarm/Life Safety use and shall be installed per NEC Article 760. Cable must be separated from any conductors of Power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, as per NEC Article 760-29.
- J. Make conduit and wiring connections to sprinkler flow switches, sprinkler valve tamper switches, duct smoke detectors, and AHU shutdown devices.

- K. Automatic Detector Installation: NFPA 72. Coordinate with mechanical contractor to install and connect smoke detectors in HVAC ductwork.
- L. Provide remote indicators/test switches for all smoke detectors (ceiling and duct) where required by code and where detector is not visible from a standing position on the floor below the detector. Wall mount detectors at 60" above finished floor. Provide conduit, surface metal raceway and junction boxes as required to mount device.
- M. All splices, taps and terminations of fire alarm conductors shall be made on binder head screw terminals only.

### 3.02 MANUFACTURER'S FIELD SERVICES

- A. Provide manufacturer's field services. The Manufacturer shall provide the on-site services of an Authorized, Factory Trained technical representative to supervise all connections and fully test all devices and components of the system during installation phase. The system shall be demonstrated to perform all the functions as specified.
- B. The Supplier shall provide comprehensive Training on the operation, proper use, testing and routine maintenance of the installed Fire Alarm System to the Building Owner's Representative.
- C. The completed fire alarm system shall be fully tested in accordance with NFPA 72 by the Contractor in the presence of the Owner's representative and the Local Fire Marshal. Upon completion of a successful test, the Contractor shall so certify in writing to the Owner and General Contractor.

### 3.03 FINAL SYSTEM ACCEPTANCE

- A. The Fire Alarm System will be accepted only after a satisfactory test of the entire system has been accomplished by a Factory-Trained Supplier in the presence of a representative of the Owner.
- B. The Supplier shall provide a complete set of "as-built" Fire Alarm/Life Safety system drawings at Substantial Completion.
- C. Provide the following in addition to as-built drawings:
  - 1. A computer file of the compiled Data Transfer Files for the installed system. (This file is intended to be a backup database for the installed system, and is not intended to be modified by any party other than the installing Engineered Systems Distributor.)
  - 2. Reports of all testing performed during installation of the system.
  - 3. Procedures for testing the Fire Alarm / Life Safety System.
- D. The Supplier shall make available contracted periodic system testing, maintenance, and/or calibration services.

### 3.04 WARRANTY

- A. The Contractor shall warrant the completed fire alarm system wiring and equipment to be free from inherent mechanical and electrical defects for a period of five years from the date of the completed and certified test or from the date of first beneficial use.
- B. The Fire Alarm Systems Components including all Control Equipment, Analog Sensors and Addressable I/O Modules shall be warranted by the manufacturer for five years. Damage by lightning shall be included in the warranty.
- C. Upon completion of the installation of the fire alarm system equipment, the electrical contractor shall provide to the architect, a signed written statement, substantially as follows:

"The undersigned, having engaged as the contractor on the (NAME OF THE PROJECT) confirms that the fire alarm system equipment installed is in agreement with the wiring diagrams and written instructions and directions provided by the Engineered Systems Distributor."

END OF SECTION

## SECTION 31 00 00

### EARTHWORK

#### 1. GENERAL:

1.1 RELATED DOCUMENTS: The General Provisions of the Contract, including the General Conditions, Supplementary Conditions and Special Conditions, along with the General Requirements, apply to the work specified in this Section.

#### 1.2 DESCRIPTION:

##### 1.2.1 Work Included:

1. Notification of Utility Companies.
2. Protection.
3. Stripping and Stockpiling Topsoil.
4. Overexcavation & Removal of Unsuitable Soils.
5. Slope Restrictions, Shoring & Bracing of Excavations.
6. Existing Soil Compaction & Preparation.
7. II Placement.
8. Layout & Establishment of Grades.
9. Grading and Reshaping Site.
10. Construction of Stormwater Ponds, Ditches & Swales.
11. Spreading of Topsoil.
12. Repair & Restoration.
13. Clean Up.

##### 1.2.2 Related Work Specified Elsewhere:

1. Site Clearing, Stripping and Grubbing: 31 20 00.

#### 1.3 REFERENCES:

##### 1.3.1 American Society for Testing and Materials (Latest Edition):

1. ASTM D698, 'Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort'
2. ASTM D1140, 'Standard Test Methods for Amount of Material in Soils Finer Than the No. 200 Sieve'
3. ASTM D1557, 'Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort'
4. ASTM D2216, 'Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock'
5. ASTM D2487, 'Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)'
6. ASTM D2922, 'Standard Test Methods for Density of Soil and Soil-

- Aggregate in Place by Nuclear Methods (Shallow Depth)'
7. ASTM D2974, 'Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils'
  8. ASTM D3017, 'Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)'
  9. ASTM D4318, 'Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils'
  10. ASTM D5268, 'Standard Specification for Topsoil Used for Landscaping Purposes'
  11. ASTM D6913, 'Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis'
  12. ASTM D448, 'Standard Classification for Sizes of Aggregate for Road and Bridge Construction'

1.3.2 Florida Department of Transportation (FDOT):

1. Standard Specifications for Roadway & Bridge Construction.

1.3.3 Florida Statutes (F.S.):

1. Chapter 556: Underground Facility Damage Prevention and Safety.

1.4 JOB CONDITIONS:

- 1.4.1 Inspection of the Site: It is the Contractor's responsibility to have carefully inspected the Site during the bidding period to determine the extent and nature of the site work and the conditions under which it must be performed.
- 1.4.2 Subsurface investigations have been completed. A copy of the Geotechnical Investigation can be found in Section 02 06 00.
- 1.4.3 Lines, Grades, Etc.: Verify all grades, lines and dimensions shown on Drawings and report any errors or inconsistencies to the Engineer before commencing work.
- 1.4.4 Should any unusual conditions arise, contact the Engineer for instructions prior to continuation of clearing and grading operations.
- 1.4.5 The site has received considerable quantities of fill placed under separate contract. The Contractor shall apprise themselves of the as-built conditions and govern their bids accordingly. Soil testing data collected during fill placement is available for review upon request.

1.5 QUALITY ASSURANCE:

1.5.1 Work specified herein will be subject to inspection and testing by an independent testing laboratory selected and compensated by the Contractor. Selection of the testing laboratory is subject to the approval of the Engineer.

1.5.2 Testing: Contractor shall employ (at the Contractor's expense) a geotechnical firm capable of performing the below compliance testing at the indicated intervals. Geotechnical firm subject to Engineer's approval.

1. The minimum compaction testing (ASTM D1557) shall be as follows for each lift of fill:

- a. One (1) test per 5,000 SF under pavement area. See also Section 32 12 19 - Asphaltic Concrete Paving.
- b. One (1) test per 10,000 SF of all other areas.

In the event an above item is not constructed on fill, the areas shall be tested as if one (1) lift of fill had been put in place. Compliance testing shall be in accordance with ASTM D2922.

2. Additionally, the following elements shall be tested (ASTM D1557) for compliance with the compaction requirements to a depth of 24" below the bearing elevation of each element. Field compliance testing shall be in accordance with ASTM D2922.

- a. One (1) test per 300 LF of utility trench.
- b. One (1) test at each utility structure.
- c. One (1) test for each 50 LF of continuous footing.
- d. One (1) test for each 2,500 sf of building slab.
- e. One (1) test for each isolated footing

3. Representative samples of each source of suitable fill shall be collected and tested for optimum moisture content (ASTM D2216), gradation (ASTM D6913) and plasticity (ASTM D4318) characteristics. Tests shall also be performed to establish moisture density relationships and fill suitability in accordance with the modified proctor method (ASTM D1557).

4. Imported Topsoil Material shall be tested as follows for each source material:

- a. pH.
- b. Determine organic material content by ASTM D2974.
- c. Presence of Herbicides.

1.6 SUBMITTALS:

- 1.6.1 Copies of all soils testing showing compliance with this section. Copies of all retests as required.
- 1.6.2 Shoring and bracing plans for excavations if required. Signed and sealed by a Florida Registered Professional Engineer.

2. MATERIALS:

2.1 Suitable On-Site or Imported Fill/Backfill:

- 2.1.1 Well graded material conforming to ASTM D2487 (SW, SP) free from debris, organic material, fat clays, brick, lime, concrete, and other material which would prevent adequate performance of the backfill.
- 2.1.2 Fill shall consist of an inorganic, non-plastic, granular soil containing less than 10 percent material passing the No. 200 mesh sieve.
- 2.1.3 All fill proposed for use at the site whether from on-site grading operations or an off-site source shall be tested as required by this section.

2.2 Topsoil: Shall be imported from off-site source.

- 2.2.1 Well graded sandy material with composted organic content in accordance with ASTM D5268.
- 2.2.2 Material shall be friable, free draining, surface soil reasonably free of grass, roots, weeds, sticks and trash.
- 2.2.3 Material shall be free of odors.
- 2.2.4 Material shall have a pH between 5.9 and 7.0 unless otherwise required by the sod supplier or landscaper.
- 2.2.5 Topsoil used under athletic fields or other landscape features finished with specialty grasses shall be treated with a pre-emergent herbicide in accordance with the grassing supplier and chemical manufacturers instructions.

2.3 Crushed Stone:

- 2.3.1 Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2 inch sieve and 0 to 5 percent passing No. 8 sieve.



2.4 Pipe Bedding and Haunching Material:

2.4.1 Natural subgrade or backfilled material shall meet the requirements of the Unified Soil Classification for SW or SP material or AASHTO Soil Classification for A-3 material.

3. INSTALLATION:

3.1 NOTIFICATION OF UTILITY COMPANIES:

3.1.1 Notify all utility companies that may have lines or services on or around the site prior to starting any work. Have the utility identify and locate their underground lines.

3.1.2 Active utilities shall be adequately protected from damage and removed or relocated only as indicated or specified. The work shall be adequately protected, supported or relocated as directed by the Engineer. Take responsibility for the repair or replacement of any lines or services damaged during the course of this work.

3.1.3 Remove, plug or cap all abandoned lines, meters, boxes, obstructions or piping in accordance with the requirements and approval of the agencies affected or as directed by the Engineer. Use licensed electricians or plumbers for this work.

3.2 PROTECTION:

3.2.1 The Contractor shall design, furnish, install and maintain all support, shoring and sheet piling which may be required for the protection of site personnel and adjacent existing improvements.

3.2.2 Maintain all bench marks, monuments and other reference points furnished by others and replace any that are disturbed or destroyed during the course of the work.

3.2.3 Protect any trees or shrubs remaining within the vicinity of the work, or as indicated to remain on drawings.

3.3 STOCKPILING OF TOPSOIL:

3.3.1 The project site has no topsoil and shall be imported by the Contractor.

3.3.2 Topsoil is required for finish grading, and shall conform to Section 2.2 All stored topsoil shall be kept clean and free of weeds and refuse.

- 3.3.3 Any topsoil not used in final grading shall first be offered to Owner; any remainder shall be removed from the site.
- 3.4 OVEREXCAVATION, REMOVAL AND REPLACEMENT OF UNSUITABLE SOILS:
  - 3.4.1 General: The following soil types shall be defined as unsuitable material: clay rich soils (SC, CL, CH, ML, MH) and organic rich soils (Pt, OH, OL). If encountered, this material is not suitable for use as backfill. Excavations for project improvements that extend into or bear on or near an unsuitable soil layer should be visually inspected and probed by the Contractor's Geotechnical Engineer. Overexcavation and removal of unsuitable soils shall be mandatory. Extent and conditions for soil removal shall be as follows:
    - 3.4.2 New Buildings and Equipment Pads:
      - 3.4.3 Vertical removal of all clay rich soils beneath the bearing elevation of the foundation shall be to a depth of 3'.
      - 3.4.4 Horizontal limits removal of clay rich soils shall be extended 5 feet beyond the perimeter of the structure.
      - 3.4.5 Overexcavation of organic rich soils shall be full depth or 10' whichever is greater for an area extending 5' beyond the structure footprint.
      - 3.4.6 Control of groundwater elevation is mandatory. Comply with Section 312319.
      - 3.4.7 Backfill excavations with compacted suitable material.
  - 3.4.1 General: The following soil types shall be defined as unsuitable material: clay rich soils (SC, CL, CH, ML, MH) and organic rich soils (Pt, OH, OL). If encountered, this material is not suitable for use as backfill. Excavations for project improvements that extend into or bear on or near an unsuitable soil layer should be visually inspected and probed by the Contractor's Geotechnical Engineer. Overexcavation and removal of unsuitable soils shall be mandatory. Extent and conditions for soil removal shall be as follows:
    - 3.4.2 New Buildings and Equipment Pads:
      - 3.4.3 Vertical removal of all clay rich soils beneath the bearing elevation of the foundation shall be to a depth of 3'.
      - 3.4.4 Horizontal limits removal of clay rich soils shall be extended 5 feet beyond the perimeter of the structure.
      - 3.4.5 Overexcavation of organic rich soils shall be full depth or 10' whichever is greater for an area extending 5' beyond the structure footprint.
      - 3.4.6 Control of groundwater elevation is mandatory. Comply with Section 312319.
      - 3.4.7 Backfill excavations with compacted suitable material.
- 3.5 All Utility Structures, Paving Areas and Underground Piping:
  - 3.5.1 Where unsuitable material occurs at subgrade elevations within the limits of construction, the Contractor shall excavate such material (for the width of the excavation) down to suitable foundation material or to a depth of two feet, whichever is less, and backfill with suitable material obtained from grading operations, borrow or imported fill
  - 3.5.2 Control of groundwater elevation is mandatory. Comply with Section 31 23 19.
  - 3.5.3 Under no circumstances shall unsuitable materials be mixed with clean fill on the jobsite. Contractor shall make every effort to separate materials including distinct separation of organics, unsuitable inorganics and suitable fill.

3.5.4 All utility structures (manholes, wetwells, precast units) shall be underlain by 8" of crushed stone (No. 57) or gravel extending 12" beyond the base. See Drawings for additional requirements.

3.6 SLOPE RESTRICTIONS, SHORING & BRACING OF EXCAVATIONS:

3.6.1 Excavations exceeding 5 feet in depth shall comply with the Trench Safety Act (F.S. 553.60-64) and shall employ the requirements of 3.6.3, 4, or 3.6.3,5 as applicable.

3.6.2 Excavation walls adjacent to existing structures and pavements, such that foundations or bearing elements could be undermined, shall be laterally supported by sheet piles.

1. Contractor shall at his expense design, furnish, and install sheet piles.
2. System shall use walers, tie-backs or deadman as necessary to prevent movement of soils under or adjacent to existing structures.
3. System shall be designed under the supervision of a Florida Registered Professional Engineer.
4. The use of jetting to install sheet piles is not allowed.
5. Refer to the Geotechnical Report for design soil pressures.
6. Upon completion of excavation activities all shoring & bracing materials shall be removed.

3.6.3 Excavations not adjacent to existing structures may be open cut.

1. Excavation walls greater than 5 feet in depth shall not exceed 2:1 (H:V).
2. Limits of excavation shall not advance beyond the property or right-of-way line.
3. Slopes shall be protected from erosion.
  - a. Construct a perimeter berm redirecting stormwater.
  - b. Apply an impervious sheeting covering slopes during rain events as necessary.
4. Excavation slopes shall be terraced every 5 feet vertically with a 4 foot wide continuous terrace. A shallow drainage ditch, 8-inches deep, shall be cut at the toe of each slope to collect stormwater.

5. In lieu of 2:1 (H:V) sideslopes the Contractor may utilize a steel trench box and ladder designed for the purpose of protecting workers in steep wall excavations.

3.6.4 See Section 31 23 19 for groundwater control requirements.

3.6.5 All utilities exposed by the excavation shall be supported or redirected as required to remain in service.

3.6.6 Differing materials removed from the excavation shall be segregated into separate piles. Suitable fill, unsuitable fill, organics and trash shall not be combined into a single pile.

### 3.7 EXISTING SOIL COMPACTION AND PREPARATION:

3.7.1 Subsequent to clearing and stripping, compact the upper 12 inches of exposed surficial sandy soils to the requirements of Paragraph B of this section.

1. Use non-vibratory or vibratory equipment (3 to 4 ton static weight roller) as allowed by groundwater levels and proximity to existing structures.
2. Provide a minimum of 4 passes.
  - a. Provide an equal number of passes in directions perpendicular to each other.

3.7.2 Minimum compaction requirements (per ASTM D1557) for excavations in or activities on existing soils shall be as follows:

1. Foundations, slabs and sidewalks	95%
2. Paving areas	98%
3. Utility trenches/pipelines and structures	98%
4. Landscaping and athletic fields	90%
5. All other areas	85%

3.7.3 If encountered, surficial exposed clayey soils should not be compacted.

1. Clayey soils beneath proposed improvements are unsuitable and shall be removed as described elsewhere in this Section.
2. Elsewhere, cover exposed clayey soils as soon as possible with suitable fill, limit access to area until soil has been covered and protected from further disturbances.

3.7.4 After completion of compaction activities, proofroll existing surface with a heavy, pneumatic tired vehicle such as a fully loaded dump truck.

1. Remove and replace soft soils with suitable fill.
2. Recompect and retest area.
3. Proofrolling shall consist of (2) two complete passes of the vehicle in opposite directions.

3.8 FILL PLACEMENT:

3.8.1 All fill material, whether from on-site or imported material, must be approved by the Geotechnical Engineer, hired and compensated by the Contractor, prior to placing it on the site.

3.8.2 Backfill Placement:

1. Within 50 feet of existing structures:
  - a. Compact soils with light (2,000 pounds or less) walk behind vibratory rollers or sleds.
  - b. Heavy (2 tons or greater) vibratory equipment shall not be allowed.
  - c. Place loose lifts not exceeding 6 inches.
2. With 24" or less separation between compaction surface and groundwater table:
  - a. Place loose lifts not exceeding 6 inches in depth.
  - b. Compact each lift using non-vibratory equipment.
3. With greater than 24" separation between compaction surface and groundwater table:
  - a. Place loose lifts not exceeding 12 inches in depth.
  - b. Compact each lift using vibratory equipment.
4. Regardless of compaction achieved all lifts shall receive a minimum of 8 passes of the compaction equipment. Provide an equal number of passes in directions perpendicular to each other.

3.8.3 Compact each lift with 3 to 4 ton static weight roller until the following % of the maximum dry density (per modified proctor max. dry density, ASTM D1557) is obtained.

- |  |     |
|--|-----|
| 1. Foundations, Slabs & Equipment Pads         | 95% |
| 2. Paving Areas, Utility Trenches & Structures | 98% |
| 3. Landscaping                                 | 90% |
| 4. All Other Areas                             | 85% |

Recompact areas which fail to meet the compaction requirements until passing results are achieved.

- 3.8.4 Compaction of utility trenches may be accomplished with a small walk behind jumping jack, until sufficient fill is in place to allow larger equipment to safely operate.
- 3.8.5 Fill shall be moisture conditioned within 2 percent of optimum moisture content. Based on ASTM D1557.
- 3.8.6 After completion of compaction activities, proofroll each lift with a heavy, pneumatic tired vehicle such as a fully loaded dump truck.
  - 1. Remove and replace soft soils.
  - 2. Recompact and retest area.
  - 3. Proofrolling shall consist of (2) two complete passes of the vehicle.
- 3.8.7 Differing materials removed from any excavation shall be segregated into separate piles. Suitable fill, unsuitable fill, organics and trash shall not be combined into a single pile.

### 3.9 LAYOUT AND ESTABLISHMENT OF GRADES:

- 3.9.1 The Owner has established the lot line bearings and project benchmark elevation.
  - 1. The Contractor shall employ and pay for the services of a Florida licensed surveyor who shall make all required surveys for establishing all points, lines, grades and levels, and otherwise fully and completely lay out all the work required by the Contract.

### 3.10 GRADING AND RESHAPING SITE:

- 3.10.1 Cut, fill, backfill, and rough grade as necessary to bring entire site level with elevations of undersides of concrete slabs, walks, paving and finished landscaping as indicated on Drawings or in Specifications.
- 3.10.2 Grade areas to receive future topsoil and sod to allow for such material. Leave finished surfaces and surfaces to receive paving smooth, compacted and free from irregular surface drainage.
  - 1. For areas receiving top soil set rough grades 4" below finish grades.
  - 2. For areas receiving sod set finish grades 1" below final grade.
  - 3. For areas receiving seed set grades at finish grades

4. It is the intent of these grade offsets for the finish surface to be a flush condition with the adjacent hardscape. Differences in sod thickness may require the Contractor to adjust these requirements to suit.

3.10.3 Surfaces and grade lines shall not vary from the established grades and slopes by more than the following tolerances:

1.	Landscaped Surfaces	0.15 feet
2.	Drainage Features	0.10 feet
3.	Areas Under Paving and Structures	0.05 feet
4.	Athletic Fields and other Playing Surfaces	0.05 feet
5.	All Other Areas	0.10 feet

3.10.4. Where elevations are indicated on the Drawings obtain such finish elevations and establish uniform slopes of finish grades between indicated elevations. Grade lines between any given elevations shall conform to the above tolerances.

3.10.5. Where elevations are not indicated, establish and obtain uniform slope from finished spot elevations at the exterior face of the building or other vertically described site element out to the nearest indicated elevations for finished grades as shown on the Drawings.

3.10.6 The Contractor shall provide suitable fill as necessary to achieve all proposed grades.

### 3.11 CONSTRUCTION OF STORMWATER DITCHES, PONDS AND SWALES:

3.11.1 Construct ponds, drainage ditches and swales as shown on the Drawings and finish to permit proper surface drainage.

3.11.2 Unless otherwise noted swales shall be graded with a minimum slope of 0.0025 ft/ft in the direction of flow.

3.11.3 All swales shall be stabilized with sod.

3.11.4 Sideslopes exceeding 2:1 shall be stabilized with sod which is staked in place to prevent movement.

3.11.5 Excavated soil shall be temporarily stockpiled in an area coordinated with the Owner.

3.11.6 Offsite swales receiving discharge from project site shall be regraded to drain as necessary.

3.12 SPREADING TOPSOIL:

- 3.12.1 Topsoil shall be imported from off-site and spread uniformly on all unimproved areas that are to receive landscaping. Remove any clay, stones larger than 3/4 inch in diameter, weeds, roots, rubbish and all other foreign matter from the topsoil.
- 3.12.2 Upon completion of the work, any surplus topsoil shall be removed from the project site and disposed of by the Contractor, unless otherwise directed by the owner.
- 3.12.3 Unless otherwise noted on the drawings topsoil shall be a minimum of 3" deep.

3.13 REPAIR/RESTORATION:

- 3.13.1 Repair damage to other portions of the Work resulting from work of this Section at no additional cost to Owner. On new work, arrange for damage to be repaired by original installer.
- 3.13.2 Disturbed areas shall be sodded or seeded and mulched as described on the Drawings or elsewhere in these specifications.

3.14 CLEAN UP:

- 3.14.1 Minimize the transmission of dirt or debris by equipment or personnel to any property, public or private, outside the project Site. Immediately remove any such debris or dirt transmitted.
- 3.14.2 Any excess fill materials left over at the conclusion of construction activities is first the property of the Owner. If not claimed by the Owner, then excess materials shall become the property of the Contractor and shall be disposed of legally at his expense.
- 3.14.3 All streets, sidewalks and paved driveways adjacent to or within the construction limits shall be swept clean of debris.

END OF SECTION



SECTION 31 23 19

DEWATERING

1. GENERAL:

1.1 RELATED DOCUMENTS: The General Provisions of the Contract, including the General Conditions, Supplementary Conditions and Special Conditions (if any), along with the General Requirements, apply to the work specified in this Section.

1.2 DESCRIPTION: The Work to be performed under this section shall include furnishing all equipment and labor necessary to remove storm or subsurface waters from excavation areas in accordance with the requirements set forth and as shown on the drawings.

1.3 APPLICABLE CODES, STANDARDS AND SPECIFICATIONS: The dewatering of any excavation areas and the disposal of the water shall be in strict accordance with the latest revision of all local and state government rules and regulations. The Contractor shall obtain any required dewatering permit from the appropriate agencies prior to commencing dewatering operations.

1.4 SUBMITTALS: Prior to the start of construction the Contractor shall provide a dewatering plan describing the surfacewater and groundwater controls which will be employed to control water levels in excavations so that construction is not inhibited.

1.4.1 Plan shall include temporary culverts, barricades and other protective measures to prevent damage to property or injury to any person or persons.

1.4.2 Plan shall indicate disposal method and location of point discharge.

1.4.3 Proof of Compliance with Florida Department of Environmental Protection Rule 62-621.300(2). See Paragraph 3.2.2 1. a.

2. MATERIALS: - NOT APPLICABLE

3. INSTALLATION:

3.1 PERFORMANCE:

3.1.1 General:

1. The Contractor shall provide adequate equipment for the removal of storm or subsurface waters which may accumulate in any excavation.

2. The Contractor shall maintain groundwater levels as follows:
  - a. 2 feet (24") below foundation bearing elevation.
  - b. 2 feet (24") below pavement base bearing elevation.
  - c. 1 foot (12") below bottom of utility pipes and structures.
  - d. Bottom of trench or other excavation shall be dry so that work can proceed.
  - e. 1 foot (12") below any other working surface.
3. System shall intercept water on all sides of area to be drawn down.
4. Contractor shall adhere to submitted Dewatering Plan.
5. Engines driving any proposed dewatering pumps shall be equipped with residential type mufflers.

3.1.2 Acceptable Methods:

1. Wellpoint System
2. Trench and Sock Drain
  - a. Dewatering by trench pumping will not be permitted if migration of fine grained natural material from bottom, side walls or bedding material will occur.

3.2 DISPOSAL:

3.2.1 General:

1. Water pumped from an excavation shall be disposed (in strict compliance with all Local, State and Federal Regulations) or in the following:
  - a. Site Stormwater Pond or other Stormwater Facility serving the project.
  - b. Temporary disposal pit or trench.
2. Direct discharge to waters of the state or other surface waters is strictly prohibited without prior written approval from the governing agency.

3. No flooding of streets, roadways, driveways or private property shall be permitted.

3.2.2 Regulatory Requirements:

1. Contractor is responsible for acquiring and complying with all permits and approvals necessary to perform the dewatering activity.
  - a. The Florida Department of Environmental Protection requires testing of groundwater prior to dewatering (F.A.C. 62-621.300(2) for each point source that discharges to waters of the State.
2. All waterways shall be protected from turbidity during the dewatering operation.

3.3 RESTORATION:

- 3.3.1 All temporary drains, pipe or other non-soil materials shall be removed at the conclusion of the dewatering activity.
- 3.3.2 Soils disturbed by the removal process shall be recompact and restabilized.

END OF SECTION



## SECTION 31 25 00

### EROSION AND SEDIMENTATION CONTROL

#### 1. GENERAL

1.1 RELATED DOCUMENTS: The General Provisions of the contract, including the General Conditions, Supplementary Conditions and Special Conditions, along with the General Requirements, apply to the work specified in this Section.

#### 1.2 SUMMARY:

1.2.1 Includes But Not Limited To: Provide, install, maintain, and remove erosion and sedimentation controls as described in Contract Documents and as required by Contractors Pollution Prevention Plan.

#### 1.2.2 Related Sections:

1. Section 31 00 00 - Earthwork
2. Section 31 23 19 - Dewatering

#### 1.3 REFERENCES:

#### 1.3.1 Florida Department of Transportation (Latest Editions):

1. Standard Specification for Road and Bridge Construction.
2. Design Standards for Design, Construction, Maintenance and Utility Operations on the State Highway System.

#### 1.3.2 Florida Department of Environmental Protection:

1. Rule 62-621 Generic Permits

#### 1.3.3 Environmental Protection Agency (EPA)

1. National Manual of Stormwater Best Management Practices.

1.4 QUALITY ASSURANCE: Contractor shall be certified by the Florida Department of Environmental Protection as an Erosion and Sedimentation Control Professional.

1.5 SUBMITTALS:

- 1.5.1 Provide copy of application and stormwater pollution prevention plan as submitted to Florida Department of Environmental Protection as required by Section 31 25 00 3.2.1 1.
- 1.5.2 Provide a copy of Notice of Termination (NOT) of coverage under FDEP Generic Permit for Large and Small Construction Activities.
- 1.5.3 Name of Certified FDEP Professional and a copy of the page of the permit application identifying the FDEP individual and their contact information.

2. MATERIALS:

2.1.1 Filter Fabric: Florida Department of Transportation Class D-3 material.

2.1.2 Sand Cement Bags:

- 1. Portland Cement: ASTM C150 Type I/II material.
- 2. Fine Aggregate: Clean silica sand or other inert natural material of similar characteristics.
  - a. 97% material passing No.4 sieve
  - b. 20% material passing No.100 sieve
  - c. 5% material passing No. 200 sieve
- 3. Sacks: Provide sacks of uniform size made of jute, cotton or scrim reinforced paper capable of holding the sand cement mixture without leakage. Sacks shall provide a finished unit approximately 12x18x6 inches in measurement. Material shall be permeable and absorptive enough to permit passage of water to provide for hydration of cement. Materials shall be biodegradable and contain no asphalt, oil or plastic lamination.

2.1.3 Rubble:

- 1. Provide clean, hard, durable rubble free of pollutants consisting of broken stone, concrete or masonry. Material shall be free of reinforcing wire or steel rebar.
- 2. Material shall have a minimum nominal dimension of 3 inches for any given piece of rubble.

2.1.4 Fiber Rolls:

1. Tube shaped rolls of straw, flax, rice, coconut fiber, or compost.
2. Rolls shall be wrapped with UV degradable polypropylene netting or biodegradable netting.

2.1.5 Silt Fence:

1. Florida Department of Transportation Type III silt fence meeting all requirements of FDOT Index 103.

2.1.6 Seed for Temporary Erosion Control:

1. Winter Months (October to March): Annual Rye Grass.
2. Summer Months (April to September): Millet Grass.

2.1.7 Water: Clean and potable.

3. INSTALLATION:

3.1 PERFORMANCE:

3.1.1 General:

1. Provide and maintain temporary erosion and sedimentation control measures from time site is disturbed to time permanent controls, paving, landscaping, and site restoration measures are able to perform erosion and sedimentation control functions.
2. Clean-out, repair, and maintain control structures as necessary to enable them to perform properly.
3. Prevent pollution of streams, water impoundments, and channels leading to them with chemicals, fuels, lubricants, bitumens, raw sewage, and other harmful waste.

3.1.2 Sediment Barriers/Silt Fence:

1. Place fence as shown on Drawings and as necessary to maintain regulatory compliance with Contractor's Pollution Prevention Plan.

2. As a minimum, Silt Fence shall be installed along all downstream project property lines and between any construction activity and all waterways, water bodies, sewer inlets and wetlands.

3.1.3 Fiber Rolls:

1. Place rolls as shown on Drawings and as necessary to maintain regulatory compliance with Contractor's Pollution Prevention Plan.

3.1.4 Seed or Sod:

1. All areas disturbed by construction, and to remain unpaved or outside the building envelope, shall be stabilized by permanent seed and mulch or sod, as described elsewhere in the contract documents. Refer to Section 32 92 00 for permanent grassing requirements.
2. Areas that will be regraded or otherwise disturbed later during construction may be seeded with a temporary seed mix to obtain temporary erosion control.

3.1.5 Sand-Cement Bag Rip Rap:

1. Proportion sand and cement in the ratio of 5 cubic feet of sand to 94 lbs of cement.
2. Fill sacks to uniform size. Keep at least 6 inches of the sacks unfilled to allow for tying and closure.
3. Place sacks as shown on the drawings. Place sacks in a running bond type pattern. Align sacks/bags so that continuous joints are perpendicular to the primary flow and staggered joints are parallel to the primary flow.
4. Stake alternating bags in place with an 18" length of #3 rebar centered in bag. Set top of bar 1" below surface of bag.
5. After placement saturate bags with water.

3.1.6 Rubble:

1. Place rubble as required by drawings or specifications.
2. Dump rubble in place so as to provide a minimum depth of 18 inches.
3. Ensure that rubble does not segregate so that smaller pieces evenly fill the voids between the larger pieces.



### 3.2 REGULATORY REQUIREMENTS:

#### 3.2.1 Florida Department of Environmental Protection (FDEP) - NPDES Program.

1. Contractor shall notify Florida Department of Environmental Protection of proposed construction and file Notice of Intent (NOI) to use Generic Permit for Stormwater Discharge from Large and Small Construction Activities with Florida Department of Environmental Protection.
2. Contractor shall be responsible for application fee and preparation of all attachments. Attachments shall include a Pollution Prevention Plan.
  - a. The minimum requirements for pollution prevention are described on the contract drawings and in these specifications.
  - b. The Contractor may use the pollution controls presented in these documents as the basis for his Pollution Prevention Plan.
  - c. The Contractor shall supplement the contract drawings and specifications as necessary to satisfy the Contractor's permit application and the Contractor's means and methods of construction.
3. It shall be the Contractor's responsibility to familiarize himself with the permit conditions and maintain the site in a condition that will be compliant with the permit.
4. Any testing or other requirements required by the governing agency to remain compliant or in response to a non-compliance event shall be the financial and material burden of the Contractor.
5. Contractor shall notify FDEP of conclusion of project and submit a notice of termination (NOT) coverage.

### 3.3 DUST CONTROL:

- 3.3.1 Contractor shall make every effort to limit the transport of windborne dust and particulates from the disturbed site.
- 3.3.2 Soil erosion due to wind shall be controlled with the application of water to dampen soil.

3.4 REPAIR AND RESTORATION:

3.4.1 If any seed is washed out before germination, repair damage, refertilize and reseed.

3.4.2 Maintain silt fence in a functional condition. Repair any damage immediately. Implement a routine maintenance schedule for all erosion schedule. All erosion control features shall be inspected immediately following all storm events.

3.5 CLEANING:

3.5.1 Remove temporary controls and accumulated sediments when permanent facilities are able to perform function and when approved by Engineer.

3.5.2 Remove accumulations of silt and other erosion products from all permanent facilities.

END OF SECTION

## SECTION 31 31 16

### TERMITE CONTROL

#### 1. GENERAL:

1.1 Related Documents: The requirements of Division 1 are hereby made a part of this section as if fully repeated herein.

1.1.1 DIRECT PURCHASING: This Section is subject to the terms and procedures of Direct Purchasing, whereby the Owner reserves the right to recover the sales tax on materials by purchasing directly the materials required for this Section. Issuance of Purchase Orders by the Owner shall not relieve the Contractor of any of his responsibilities regarding material purchases or installations, with the exception of the payments for the materials as purchased.

1.2 Summary: Provide soil treatment for termite control as herein specified. Chemically treat the compacted soil under all concrete floor slabs prior to the installation of the vapor barrier. Areas of interior slab repairs or patching for the construction require soil treatment. Exterior sidewalks do not require treatment.

#### 1.3 Submittals

1.3.1 Product Data: Submit manufacturer's technical data and application instructions.

#### 1.4 Quality Assurance

1.4.1 In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work, including preparation of substrate and application.

1.4.2 Engage a professional pest control operator, licensed in accordance with regulations of governing authorities for application of soil treatment solution.

1.4.3 Use only termiticides, which bear a Federal registration number of the U.S. Environmental Protection Agency.

#### 1.5 Job Conditions

1.5.1 Restrictions: Do not apply soil treatment solution until excavating, filling and grading operations are completed, except as otherwise required in construction operations.

1.5.2 To insure penetration, do not apply soil treatment to frozen or excessively wet soils or during inclement weather. Comply with handling and application instructions of the soil toxicant manufacturer.

## 1.6 Specific Product Warranty

1.6.1 The Subcontractor for the initial soil poisoning must furnish a service agreement stating the Work performed will be guaranteed for a period of 10 years from the date of Substantial Completion and that the structure will be inspected yearly for infestation and treatment provided as necessary. The Subcontractor shall offer an Optional renewal of the Service on the same terms. The Service Agreement shall state that in the event of damage during the Guarantee Period, the Subcontractor shall make repairs to structurally damaged surfaces to a dollar value based on the size of the building. An Independent Testing Laboratory shall certify that the treatment meets the requirements of the Specifications.

## 2. PRODUCTS

### 2.1 Soil treatment solution

2.1.1 Use an emulsible concentrate termiticide for dilution with water, specially formulated to prevent infestation by termites. Fuel oil will not be permitted as a diluent. Provide a solution consisting of one of following chemical elements and concentrations:

- A. Chloropyrifos (“Dursban TC”); 1.0 percent in water emulsion.
- B. Permethrin (Dragnet”, “Torpedo”); 0.5 percent in water emulsion.

2.1.2 Other solutions may be used as recommended by Applicator if also acceptable to Architect and approved for intended application by jurisdictional authorities. Use only soil treatment solutions, which are not injurious to planting.

## 3. EXECUTION

### 3.1 Application

3.1.1 Surface Preparation: Remove foreign matter, which could decrease effectiveness of treatment on areas to be treated.

- A. Loosen, rake and level soil to be treated, except previously compacted areas under slabs and foundations.

- B. Toxicants may be applied before placement of compacted fill under slabs if recommended by toxicant manufacturer.

3.1.2 Application Rates: Apply soil treatment solution as follows:

- A. Under slab-on-grade structures, treat soil before concrete slabs are placed, using the following rates of application
  - 1. Apply 4 gallons of chemical solution per 10 lin. ft. to soil in critical areas under slab, including entire inside perimeter inside of foundation walls, along both sides of interior partition walls, around plumbing pipes and electric conduit penetrating slab, and around interior column footers.
  - 2. Apply one gallon of chemical solution per 10 sq. ft. as an overall treatment under slab and attached slab areas where fill is soil or unwashed gravel. Apply 1-1.2 gallons of chemical solution to areas where fill is washed gravel or other coarse absorbent material.
- B. Apply 4 gallons of chemical solution per 10 lin. ft. of trench, for each foot of depth from grade to footing, along outside edge of building.
  - 1. Dig a trench 6" to 8" wide along outside of foundation to a depth of not less than 12".
  - 2. Punch holes to top of footing at not more than 12" o.c. and apply chemical solution.
  - 3. Mix chemical solution with the soil as it is being replaced in trench.
- C. At hollow masonry foundations or grade beams, treat voids at rate of 2 gal. Per 10 lin. ft. poured directly into the hollow spaces.

3.1.3 Post signs in areas of application to warn workers that soil termiticide treatment has been applied. Remove signs when areas are covered by other construction.

3.1.4 Reapply soil treatment solution to areas disturbed by subsequent excavation, landscape grading, or other construction activities following application.

END OF SECTION



## SECTION 32 12 16

### ASPHALTIC CONCRETE PAVING

#### 1. GENERAL:

1.1 DESCRIPTION OF WORK: The extent of asphaltic concrete paving work is shown on the drawings.

#### 1.2 SUBMITTALS:

1.2.1 Material Certificates: Provide copies of material certificates including design mixes, signed by the Contractor, certifying that each specified material complies with, or exceeds requirements.

1.2.2 Copies of all compliance testing, certifications and retests.

1.2.3 Comply with Section 01300, Submittals.

#### 1.3 JOB CONDITIONS:

1.3.1 Weather Limitations: Apply prime and tack coats only when ambient temperature is above 50 degrees F and when temperature has not been below 35 degrees F for 12 hours immediately prior to application. Do not apply when base contains an excess of moisture.

1.3.2 Construct asphalt concrete surface only when atmospheric temperature is above 50 degrees F and when base is dry. Base course may be placed when air temperature is above 30 degrees F and rising.

1.3.3 Do not lay base or asphalt when free surface water is present on the material below.

1.4 RELATED DOCUMENTS: The General Requirements of the Contract, including the General Conditions, Supplementary Conditions, and Special Conditions (if any), along with the General Requirements, apply to the work specified in this Section.

#### 1.5 REFERENCES:

1.5.1 American Society For Testing And Materials (ASTM), latest edition:

1. ASTM C131, 'Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.'
2. ASTM D 977, 'Standard Specification for Emulsified Asphalt.'

3. ASTM D 1075, 'Standard Test Method for the Effect of Water on Compressive Strength of Compacted Bituminous Mixtures.'
4. ASTM D 1188, 'Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens.'
5. ASTM D 1559, 'Standard Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus.'
6. ASTM D 2027, 'Standard Specification for Cutback Asphalt (Medium-Curing Type).'
7. ASTM D 2041, 'Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures.'
8. ASTM D 2397, 'Standard Specification for Cationic-Emulsified Asphalt.'
9. ASTM D 2939, 'Standard Test Methods for Emulsified Bitumens Used as protective Coatings'
10. ASTM D 2726, 'Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens.'
11. ASTM D 3381, 'Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction.'
12. ASTM D 5167 Practice for Melting of Hot-Applied Joint and Crack Sealant and Filler for Evaluation.
13. ASTM D 5329, 'Standard Test Methods for Sealants and Fillers, Hot-Applied, for Joints and Cracks in Asphaltic and Portland Cement Concrete Pavements.'
14. ASTM D 6690, 'Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.'

1.5.2 American Association of Safety, Highway and Traffic Officials (AASHTO):

1. AASHTO M 173 Standard Specification for Concrete Joint-Sealer, Hot-Poured Elastic Type.

1.5.3 Florida Department of Transportation (FDOT), latest edition:

1. FDOT 'Standard Specifications for Road and Bridge Construction.'
2. FM – 5 – 515 'Florida Method of Test for Limerock Bearing Ratio.'

2. MATERIAL:

2.1 Subgrade: All roadway stabilized subgrade, as required shall comply with Section 914, of FDOT Standard Specifications.

2.1.1 Base Course: Limerock Base - Material shall be as specified in Section 911, Limerock Material for Base and Stabilized Base, of the Standard FDOT Specifications. Limerock shall be mined from an FDOT approved source pit.



- 2.1.1 Asphaltic Concrete Pavement: Asphalt pavement shall be Type SP, Fine, Traffic Level C. However, the wear course shall be Type SP-9.5 or 12.5 only. Materials shall conform to the following: Section 334, Superpave Asphalt Concrete; Section 901, Coarse Aggregate; Section 902, Fine Aggregate; Section 916, Bituminous Material; and Section 917, Mineral Filler of the FDOT Standard Specifications for Road and Bridge Construction (Latest Edition).
1. Use of RAP (Recycled Asphalt Pavement) shall be limited to a maximum of 15% of mix by weight of total aggregate.
  2. If used, provide RAP with a minimum average asphalt content of 4.0% by weight.
  3. If used, RAP must be from a traceable source.
  4. RAP shall use a PG 58-22 binder.
- 2.1.2 Priming: Prime coat shall be emulsified asphalt of a grade applicable to the base used meeting the requirements of Section 916, Bituminous Material of the FDOT Standard Specifications. Cover material for prime coat shall be hot asphalt coated sand meeting the requirements of Section 902, Fine Aggregate of the FDOT Standard Specifications.
- 2.1.3 Tack Coat: Use RA-500 material meeting the requirements of section 916-2 of FDOT Standard Specifications.
- 2.1.4 Striping: Marking and striping shall utilize products meeting or exceeding requirements as specified below.
1. Thermoplastic Pavement Marking materials shall comply with the following: Section 971-1, General Requirements; Section 971-5, Thermoplastic Materials for Traffic Stripes of the FDOT Standard Specifications.
  2. Painted Striping materials shall comply with the following: Section 971-1, General Requirements; Section 971-4, Fast Dry Solvent Traffic Paint; and Section 971-2, Glass Spheres of the FDOT Standard Specifications.
    - a. Parking stall striping shall be non reflective.
- 2.1.5 Raised Pavement Markers: Shall be FDOT Type 911-4"x4"

2.1.6 Pre-emergent herbicide:

1. Selective type pre-emergence control chemical suitable for use under pavement.
2. Application personnel shall be certified in the state of Florida for application of agricultural chemicals.

2.1.7 Hot Mix Asphalt Sealant:

1. Comply with ASTM D6690, ASTM D5329 AASHTO M173.
2. Product shall be a mix of asphaltic cement, reinforcing fillers and synthetic rubbers.
3. Acceptable Products: Beram 190, Crackmaster 3405 or approved equal.

2.1.8 Traffic Signs:

1. All signs shall conform to MUTCD requirements.
2. Signs shall be made from 6061-T6 or 5052-H38 aluminum alloy in conformance with ASTM B209.
3. All background sheeting applied to the panel shall be retroreflective in accordance with ASTM D4956.
4. Posts shall be punched steel channel, perforated steel tube or solid steel tube. All steel shall be hot dip galvanized.
5. Signs shall be permanently affixed with a "born on" date that states the date of manufacture and origin.
6. All fasteners shall be 316 stainless steel.

3. INSTALLATION:

- 3.1 Survey and stake surfaces to show grading required by Contract Documents. Use a Florida Registered Professional Land Surveyor to provide all horizontal and vertical layout.
- 3.2 Subgrade: Unless otherwise noted, subgrade shall be a minimum of twelve (12) inch deep and extend a minimum of 6 inches beyond the limits of base material and/or curbing. Contractor may, at his own discretion, increase the depth of the prepared

subgrade as necessary to accommodate his equipment needs at no additional cost. Constructed stabilized subgrade shall be mixed, moisture conditioned and compacted to 98% of the maximum density (ASTM D 1557). Prepared material shall provide a limerock bearing ratio (LBR) of 40. The subgrade shall be constructed as specified in Section 160, Stabilizing of the FDOT Standard Specifications for Road & Bridge Construction (Latest Edition).

1. Fine grade surface area to accommodate finish grades required by Contract Documents.
2. Prepared surface shall be proof-rolled with a heavy pneumatic tired vehicle.
  - a. Proof-roll entire surface area a minimum of two passes in each direction.
  - b. Remove material from soft areas and replace with new material. Failing areas shall be reconstructed to the full depth of the material. If necessary, additional stabilizing material shall be added. Recompact and retest.
3. Plasticity index shall not exceed 8 and liquid limit shall not exceed 30 in prepared material.

### 3.3 Pre-emergent Herbicide:

1. Apply to prepared subgrade dispersed in liquid. Concentrate shall be such that Manufacturer's full recommended rate of chemical will be applied to every 1000 sq ft and liquid will penetrate a minimum of 2 inches.
2. Application shall be no more than one day before installation of base.
3. Take necessary precautions to protect adjoining property and areas designated for planting on building site.

### 3.4 Limerock Base Course: Limerock shall be moisture conditioned and compacted to a LBR of 100. Thickness shall be as shown on the drawings. Base shall be constructed as specified in Section 200, Rock Base of FDOT Standard Specifications.

1. Surface shall be uniform and free of birdbaths.
2. Surface variations in prepared base material shall not exceed 1/4" when measured with a 12' straight edge.
3. Base material shall extend a minimum of 6 inches beyond the limits of asphalt paving.

- 3.5 Priming: All base material shall be primed. Prime coat shall be applied in accordance with Section 300, Prime and Tack Coats For Base Courses of the FDOT Standard Specifications. Cover material for prime coat shall be applied with approved distributor.
- 3.6 Tack Coat: All existing asphalt and any concrete surfaces that will be in contact with the asphalt course shall receive a tack coat. Tack coat shall be applied in accordance with Section 300 Prime and Tack Coats For Base Courses of the FDOT Standard Specifications.
- 3.7 Asphaltic Concrete Pavement: Thickness and Type shall be as shown on the drawings and shall be constructed as specified in Section 320, Hot Bituminous Mixtures-Plant, Methods, and Equipment; Section 330, Hot Bituminous Mixtures-Quality Assurance, General Construction Requirements and Acceptance Procedures; and Section 334, Superpave Asphaltic Concrete of the FDOT Standard Specifications for Road and Bridge Construction (Latest Edition).
1. Wear course shall be Type SP-9.5, SP-12.5 (Fine) only.
  2. Surface shall be uniform and free of birdbaths.
  3. Surface variations in wear surface shall not exceed 1/4" when measured with a 12' straight edge.
  4. Spreading:
    - a. Spread material in a manner that requires the least handling.
    - b. Where thickness of finished paving will be 3" or less, spread in one layer.
  5. Rolling:
    - a. After the material has been spread to the proper depth, roll until the surface is hard, smooth, unyielding, and true to the thickness and elevations shown on the drawings.
    - b. Roll in at least two directions until no roller marks are visible.
  6. Temperature: Asphalt mix shall be between 240 degrees Fahrenheit and 360 degrees Fahrenheit at time of placement
- 3.8 Paving shall not proceed if subgrade and base are too wet or too dry. Subgrade and Base materials shall be within their respective acceptable range of optimum moisture content. Under no circumstances shall pavement be installed if standing water is present on the base material or during a rain event.

### 3.9 ASPHALT OVERLAY:

- 3.9.1 Existing asphalt surface to receive overlay shall be mechanically swept, pressure washed and cleaned of loose material. Asphalt surface shall be free of all vegetation and other debris for the limits of the work.
- 3.9.2 Cracks over 1/4 inch in width shall be filled with a hot mix asphalt sealant in accordance with ASTM D 5167 and the sealant manufacturers requirements.
- 3.9.3 Exposed concrete and asphalt to be in contact with new asphalt shall receive a tack coat.
- 3.9.4 Exposed base shall be primed and asphalt surface patched to match surrounding grade.
- 3.9.5 Where localized depressions occur that exceed 1/2" in depth over 12 inches. The asphalt shall be sawcut, removed and the base replaced for its full depth. The asphalt surface shall be patched to match the surrounding grade prior to installation of final overlay.
- 3.9.6 Where divotting or other depressions occur due to loss of asphalt and are entirely contained within the asphalt layer, the divot shall be patched with a hot or cold mix asphalt repair to match existing grade prior to installation of the final overlay.
- 3.9.7 Curbing, asphalt edges or cracks within the paved area that exhibit vegetative growth shall be treated with an appropriate herbicide prior to installation of the new paving. Vegetation extending onto the asphalt surface shall be trimmed at the edge of pavement and removed.
- 3.9.8 Where pavement edges have been damaged due to vehicular activity across the edge the contractor shall sawcut a new edge, remove all debris and install a hot or cold patch to original limits of pavement.
- 3.9.9 Asphalt shall be spread and rolled as described in paragraph 3.7 4. of this section. Except that the paving contractor shall identify the joints in the existing pavement and shall avoid matching these joints with the new paving. Existing pavement joints shall be centered as much as possible beneath the swath of new asphalt.

### 3.10 STRIPING:

- 3.10.1 Pavement Marking and striping shall be applied in accordance with Section 709, Traffic Stripes and Markings-Two Reactive Components; Section 710, Painted Pavement Marking; and Section 711, Thermoplastic Traffic Stripes and Markings of the FDOT Standard Specifications for Road and Bridge

Construction (Latest Edition). Type and location of marking to be used shall be as follows unless otherwise described on the Drawings:

1. Thermoplastic Stripes: (100 mils, Minimum Thickness):
  - a. All striping to occur within Federal, State or Local right of way.
  - b. All striping on private property to be applied within a travel lane including:
    - 1) Stop Bars
    - 2) Directional Arrows
    - 3) Message Lettering
    - 4) Other Symbols applied within the travel lane.
2. Painted Stripes: (25 mils, Minimum Thickness):
  - a. Parking stalls and symbology
  - b. Solid and Skip lane designation striping on private property.
  - c. Curb striping
  - d. Temporary striping

3.10.2 Thermoplastic striping shall be applied to asphalt pavement that has cured for a minimum of 14 days.

3.10.3 Contract shall include temporary striping for all striping, messages and symbols that will receive thermoplastic striping as the permanent marking.

3.10.4 Temporary striping shall be completed prior to substantial completion.

3.10.5 Temporary striping shall be in place within 24 hours of pavement installation.

3.10.6 Existing pavement, with modified traffic patterns, shall receive temporary striping in the event permanent striping is delayed or unavailable when traffic is allowed to use said pavement.

3.10.7 Contractor shall provide temporary striping as necessary for the duration of the work.

3.10.8 Where new automotive or pedestrian traffic patterns are to occur on existing pavement, all existing striping marking the old pattern shall be removed.

3.10.9 If requested by local AHJ, all thermoplastic striping shall be certified for thickness and retro reflectivity by the installer in accordance with FDOT requirements.

3.10.10 Permanently painted surfaces shall completely cover the asphalt surface below.

3.11 FIELD QUALITY CONTROL:

3.11.1 All work shall meet the requirements of the FDOT.

3.11.2 Surface of completed work shall not contain irregularities greater than 1/4" when checked with a 12 foot straight edge.

3.11.3 Permanent painted stripes shall completely cover asphalt below. Bleed through of aggregate or asphalt within the painted area shall require additional coating at the Contractor's expense.

3.12 TESTING:

3.12.1 Stabilized subgrade material tests shall be made as follows:

1. Determine optimum moisture/density relationship of stabilized subgrade material in accordance with ASTM D1557. Verify moisture content of in-place material (ASTM D2216) is within 4%  $\pm$  of optimum.
2. Perform in-place density tests (ASTM D1557) in the compacted stabilized subgrade material at the rate of one test for every 5,000 sf or fraction thereof. Recompact areas which fail to meet compaction requirements, then retest until passing results are obtained. Reference test locations to easily identified points on Site Plan.

3.12.2 Base material tests shall be made as follows:

1. Determine optimum moisture/density relationship of base material in accordance with ASTM D1557. Verify moisture content of in-place material (ASTM D2216) is within 2% ( $\pm$ ) of optimum. Moisture content shall be verified within 24 hours prior to paving operations.
2. Perform in-place density tests in the compacted base material at the rate of one test for every 5,000 sf or fraction thereof. Recompact areas which fail to meet compaction requirements, then retest until passing results are obtained. Reference test locations to easily identified points on Site Plan.
3. Base material shall be cored for thickness at the rate of one test for each 5,000 sf of surface area. Passing tests shall be within 1/2" of specified thickness. Where material fails to meet the required thickness existing material shall be removed and subgrade cut down

to accept additional material as required. Area shall be recompact and retested as required by item 3.13.2 2. above.

3.13.3 Asphalt tests shall be made as follows:

1. At the start of paving operations, obtain one sample each of binder (if specified) and wearing surface asphalt delivered to the job. Conduct extraction and gradation analysis, Marshall Stability, and laboratory-compacted bulk specific gravity for each sample.
2. Upon completion of paving, obtain at least two 4-inch diameter cores through the asphalt paving for all areas up to 10,000 sq. feet and one additional core for each additional 10,000 sq. feet or fraction thereof. Grout core holes with non-shrink grout after core removal. Reference test locations to easily identified points on the Site Plan.
3. Measure each asphalt core for thickness and test for bulk specific gravity. Compute the compaction percentage of each core, using the bulk specific gravity of the laboratory compacted specimen as the compaction standard.
4. Asphalt thickness shall not be more than 1/4" thinner than the specified thickness.

3.13.4 Copies of all testing shall be provided to the Owner and Engineer directly from the testing laboratory.

3.13.5 All testing, retesting and remedial work shall be at the Contractor's expense.

3.13.6 Failing results for any of the testing above shall be cause for rejection of all or part of the work performed. Contractor shall reconstruct deficient work at no additional cost to the Owner.

3.14 CLEANUP:

3.14.1 Contractor shall remove excess and waste material and properly dispose of off-site.

3.14.2 Subsequent to Substantial Completion, the Contractor shall perform a final sweeping of all newly paved areas and existing pavement immediately adjacent to the work area as necessary to provide a clean and neat appearance.

END OF SECTION



## SECTION 32 13 00

### CONCRETE PAVING, SIDEWALK AND CURB

#### 1. GENERAL

- 1.1 RELATED DOCUMENTS: The General Provisions of the contract, including the General Conditions, Supplementary Conditions and Special Conditions, along with the General Requirements, apply to the work specified in this Section.
- 1.2 REFERENCES: All work shall be in accordance with Section 522 Concrete Sidewalk, Section 350 Cement Concrete Pavement, and Section 520 Concrete Gutter, Curb Elements & Traffic Separator of the latest edition of the "Florida Department of Transportation Standard Specifications for Road and Bridge Construction" unless specifically stated or directed otherwise.
- 1.3 SUBMITTALS:
  - 1.3.1 Material Certificates: Provide copies of material certificates including design mixes, signed by the Contractor, certifying that each specified material complies with, or exceeds requirements.
  - 1.3.2 Provide manufacturer's literature and installation instructions for all concrete accessories such as joint filler and detectable warning textures.
  - 1.3.3 Copies of all compliance testing and retests.

#### 2. MATERIALS

- 2.1 CONCRETE MIX, DESIGN AND TESTING:
  - 2.1.1 Comply with requirements of applicable FDOT Section 346 for Class I concrete mix design, sampling and testing, and quality control, and as herein specified.
  - 2.1.2 Design the mix to produce standard weight concrete consisting of portland cement, aggregate, air-entraining admixture and water to produce the following properties:
    - 1. Compressive Strength:
      - a. Sidewalks: 3,000 psi @ 28 days

- b. Pavement: 4,000 psi @ 28 days
- c. Curb: 3,000 psi @ 28 days

2. Air Content: 3% to 6%

2.1.3 Concrete placement slump shall not exceed plus or minus 1 inch from approved design slump.

2.1.4 Aggregates: Aggregate shall be 3/8" round with the following sieve graduation:

<u>Size</u>	<u>% Passing</u>
1"	100
3/4"	100
3/8"	90-100
#4	40-60
#8	0-10

2.1.5 Water: Potable, clean, fresh, free from oil, acid, organic matter or other deleterious substances.

2.2 WELDED WIRE FABRIC: ASTM A185, welded steel wire fabric, 65 ksi, flat sheets only.

2.3 DEFORMED BARS: ASTM A615, carbon steel, Grade 60.

2.4 DETECTABLE WARNING TEXTURE: Prefabricated resin mat with embeds for attachment to wet concrete or predrilled for manufacturer recommended anchor system. Truncated dome surface shall conform to ADAAG 4.29.2. Color shall contrast with concrete surface. Provide federal yellow or brick red as appropriate.

2.5 JOINT MATERIAL: Closed cell expanded polyethylene foam of dimensions shown on Drawing.

2.6 FORM MATERIALS: Unless otherwise indicated, construct formwork with plywood, metal, metal framed plywood faced or other acceptable panel type materials to provide continuous, straight, smooth, exposed surfaces.

2.7 CHEMICAL HARDENER: Hardener shall be a colorless, aqueous solution of zinc or magnesium fluosilicate. Approved proprietary hardeners shall be delivered ready for use in the manufacturer's original containers.

### 3. INSTALLATION

#### 3.1 CONCRETE SIDEWALK & PAVEMENT INSTALLATION:

3.1.1 General: Sidewalk, Curb and Pavement shall be installed where indicated on the drawings. Width of surface shall be as called out on the drawings.

1. All sidewalk shall be a minimum of 4-inches thick and unreinforced.
2. All sidewalk at driveways or other areas subject to vehicular traffic shall be 6-inches thick with 6x6, W1.4xW1.4 welded wire fabric reinforcement. The length of 6-inch thick sidewalk shall extend 5' each side of gated entries.
3. All pavement shall be thickness described on drawings.

#### 3.1.2 Surface Preparation:

1. Construct stabilized sub-grade within limits of proposed sidewalk or pavement and level with the underside of concrete. Stabilization material and procedures shall be as described in the FDOT Standard Specifications for Road and Bridge Construction.
  - a. Sidewalks: Construct 6" thick stabilized subgrade.
  - b. Pavement and Curb: Construct 12" thick stabilized subgrade.
2. Proof-roll prepared sub-grade surface to check for unstable areas and the need for additional compaction.
3. Remove loose material from the compacted sub-grade surface immediately before placing the concrete.
4. Sub-grade for sidewalks shall be compacted to a minimum of 98 percent of AASHTO T 180 density and achieve an LBR value of 40.
5. Density tests shall be required for every 300 LF of sidewalk installed, at a minimum.
6. Where failing density tests occur, Contractor shall be required to recompact and retest area in both directions from point of failure to insure proper compaction has been achieved.

7. Subgrade preparation and construction for a concrete pavement section shall be subject to the subgrade requirements described in Section 32 12 16 - Asphaltic Concrete Paving including all testing requirements.

### 3.1.3 Concrete Placement:

1. Do not place concrete until sub-base and forms have been checked for line and grade. Moisten if required to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around meter boxes or other structures until they are completed to required finish elevation and alignment.
2. Place concrete using methods which prevent segregation of the mix. Consolidate concrete along the face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocation of reinforcing, dowels and joint devices. Do not use vibrators to push or move concrete in forms or chute.
3. Deposit and spread concrete in a continuous operation between transverse joints as far as possible. If interrupted for more than  $\frac{1}{2}$  hour place a construction joint.
4. Joints: Construct expansion, weakened-plane (contraction), and construction joints true-to-line with face perpendicular to surface of the concrete, unless otherwise indicated. Construct transverse joints at right angles to the centerline, unless otherwise indicated. When joining existing structures, place transverse joints to align with previously placed joints, unless otherwise indicated.
  - a. Weakened-Plane Joints: Construct weakened-plane joints for a depth equal to at least 1  $\frac{1}{4}$ -inch thickness or  $\frac{1}{4}$  the pavement thickness whichever is greater, by sawing within six to eight hours of placement or formed during finishing operations. Place joints as described on drawings.
  - b. Construction Joints: Place construction joints at the end of all pours and at locations where placement operations are stopped for a period of more than  $\frac{1}{2}$  hour, except where such pours terminate at expansion joints. Construction joints shall be standard metal keyway-section form of appropriate height.

c. Expansion Joints:

- (1) Provide premolded joint filler for expansion joints abutting concrete curbs, catch basins, manholes, inlets, structures, walks and other fixed objects, unless otherwise indicated.
- (2) Locate expansion joints as described on the drawings.
- (3) Extend joint fillers full-width and depth of joint, and not less than 1/2" below finished surface where joint sealer is indicated. If no joint sealer, place top of joint filler flush with finished concrete surface.
- (4) Furnish joint fillers in one-piece lengths for the full width being placed, wherever possible. Where more than one length is required, lace or clip joint filler sections together. Pieces shorter than 4' shall not be used unless specifically shown as such.
- (5) Protect the top edge of the joint filler during concrete placement with a metal cap or other temporary material. Remove protection after concrete has been placed on both sides of joint.
- (6) Fillers and Sealants: Comply with the requirements of these specifications for preparation of joints, materials installation, and performance and as herein specified.

3.1.4 Concrete Finishing:

1. After striking-off and consolidating concrete, smooth the surface by screeding and floating. Use hand methods only where mechanical floating is not possible. Adjust the floating to compact the surface and produce a uniform texture.
2. All sidewalk surfaces shall be cross sloped (1.0%) to provide positive drainage towards curbing or grassed area.
3. All pavement surfaces shall be sloped to grades shown on the drawings.
4. After floating, test surface for trueness with a 20' straightedge. Variations exceeding 1/4" for any two points within 10' shall not be acceptable. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide a continuous smooth finish.

5. Work edges of slabs, gutters, back top edge of curb, and formed joints with an edging tool, and round 10 ½" radius, unless otherwise indicated. Eliminate any tool marks on concrete surface.
  6. After completion of floating and when excess moisture or surface sheen has disappeared, broom finish surface by drawing a fine-hair broom across concrete surface, perpendicular to the line of traffic.
  7. Do not remove forms for 24 hours after concrete has been placed. After form removal, clean up ends of joints and point-up any minor honeycombed areas.
- 3.1.5 Curing: Protect and cure finished concrete paving and walks, as required. Use moist-curing methods for initial curing whenever possible or approved concrete curing compounds.
- 3.1.6 Repairs and Protections:
1. Repair or replace broken or defective concrete as directed by the Engineer.
  2. Drill test cores where directed by the Engineer, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy resin grout.
  3. Protect concrete from damage until acceptance of work. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
  4. Sweep concrete pavement and wash free of stains and discolorations, dirt and other foreign material just prior to final inspection.

END OF SECTION

## SECTION 32 31 13

### CHAIN LINK FENCING AND GATES

#### 1. GENERAL:

1.1. Related Documents: The requirements of Division 1 are hereby made a part of this section as if fully repeated herein.

1.1.1. DIRECT PURCHASING: This Section is subject to the terms and procedures of Direct Purchasing, whereby the Owner reserves the right to recover the sales tax on materials by purchasing directly the materials required for this Section. Issuance of Purchase Orders by the Owner shall not relieve the Contractor of any of his responsibilities regarding material purchases or installations, with the exception of the payments for the materials as purchased.

1.2. Scope: Provide and install galvanized and vinyl coated galvanized chain link fencing as indicated. Provide gates and all necessary accessories for a complete installation.

#### 1.3. Submittals

1.3.1. Shop Drawings shall be submitted for approval prior to any fabrication or delivery of materials to the site. Drawings shall indicate all details of fabrication and installation.

1.3.2. Submit manufacturer's data on all fencing materials.

1.3.3. Provide sign and sealed calculations from a Florida registered engineer showing that the fencing complies with the wind pressures indicated on the structural drawings.

#### 1.4. Certificates

1.4.1. Upon request Contractor shall provide Certificates of Compliance with the applicable standards and referenced Specifications.

#### 1.5. Coordination

1.5.1. Contractor shall examine and accept grading at fence line.

1.5.2. Grade should be such that approximately two inches between the fence fabric and the ground shall be held along the line of the fence.

#### 2. PRODUCTS:

- 2.1. Chain link fencing shall be 9 gauge 2" mesh hot dipped galvanized after weaving knuckle and knuckle top and bottom regardless of the fence heights. Do not provide any barbed selvage on this project. Provide vinyl coated chain link fencing where indicated.
- 2.2. Finishes:
  - 2.2.1. Galvanized Surfaces: Galvanize surfaces in accordance with ASTM A 123, with a coating of at least 1.20 oz/sq.ft Accessories and Components: Same finish as fabric.
  - 2.2.2. Vinyl Coating: Fabric/Vinyl Coated Steel: Chain link fence fabric shall be galvanized steel wire with a continuously bonded vinyl coating, with a finish size (i.e., size after coating) of 8 gauge, and shall comply with ASTM F 668. Mesh shall be vertically-woven diamond mesh, with a nominal distance of 2 inches (50 mm) between parallel wires.
    - A. The vinyl coating shall conform to FS RR-F-191/1C.
    - B. Colors shall be stabilized, and shall have a light fastness to withstand a minimum Weather-O-Meter exposure of at least 1500 hours without deterioration when tested in accordance with ASTM D 1499.
    - C. Specific gravity shall be between 1.26 and 1.30 in accordance with ASTM D 792.
    - D. Hardness shall be A90 +/-5 in accordance with ASTM D2240.
    - E. Tensile strength shall be between 2600 and 3000 psi (17.94 MPa and 20.7 MPa) in accordance with ASTM D 412.
    - F. Vinyl coating shall be exposure-resistant to dilute solutions of most common mineral acids, sea water, salts, and alkali.
    - G. Vinyl coating shall be continuously bonded to the wire under 5000 psi (34.5 MPa) pressure before the wire is woven into fabric.
- 2.3. Top rail shall be 1- 5/8" O.D. hot dipped galvanized inside and outside with wall thickness to be .140 and weight to be 2.280 lbs. per foot. 21 ft lengths, schedule 40 only.
- 2.4. Line posts shall be hot dipped galvanized inside and outside schedule 40 only. 2" O.D. with wall thickness of .145 for all fence heights.
- 2.5. Terminal posts shall be 3" O.D. hot dipped galvanized inside and outside wall thickness to be .154 and weight per foot 3.650 lbs. Schedule 40 only unless specified below.
- 2.6. All fencing shall be constructed with a top rail.
- 2.7. Tension Wire: 7 gauge, galvanized, continuous. Install through line posts. Bottom tension wire shall be woven through fabric and pulled taught.
- 2.8. Fencing height shall be 6' high unless noted otherwise.
- 2.9. Gates



2.9.1. All gates are to be constructed of schedule 40 pipe with wall thickness of .140 or greater. Gate pipe shall be hot dipped galvanized, inside and outside and of welded construction. All welds are to be chipped and wire brushed and brush painted with cold galvanized coating.

<u>Gate Length</u>	<u>Fencing Height</u>	<u>Gate Terminal Post</u>
≥ 10 ft.	≥ 6 ft.	4" dia/sch. 40
< 10 ft.	≥ 6 ft.	3" dia/sch. 40

2.9.3. Gate Hardware

- a. All gates shall be equipped with a 3/16" galvanized chain welded to the gate. The chain shall extend 8" on each side of the link welded to the gate for locking purposes.
- b. All swinging gates shall have "Bulldog" industrial hinges only.
- c. Provide T-handle locking device at all gates.

2.10. Fencing at equipment cages shall be 6' high. All cages will have 4' - 0" single gates unless indicated otherwise. Provide fencing at all A/C equipment not enclosed otherwise.

2.11. All fencing with a straight run of 400' or greater shall have a center pull post and bracing installed.

2.12. All terminals shall have bracing installed.

3. EXECUTION

3.1. New fencing: Provide new fencing and gates as indicated. Provide terminal post where new fencing intersects existing.

3.2. Removal of debris: Contractor shall remove all fencing components left over at the completion of the project, whether generated from new fence work or from retrofitting or removing of existing fencing, and dispose of properly off-site.

3.3. Installation:

3.3.1. Install framework, fabric, and accessories in accordance with ASTM F567 and manufacturer's recommendations.

3.3.2. Set terminal and line posts plumb in concrete footings with top of footing 4 inches below finish grade. Embed terminal posts in 12 inch x 36 inch deep concrete. Embed line posts in 12 inch x 24 inch concrete.

3.3.3. Stretch fabric between posts or at intervals of 100 feet maximum, whichever is less.

- 3.3.4. Fasten fabric to top rail, line posts, braces, and bottom tension wire with wire ties spaced 15 inches on center using the double twist method on each tie.
  - 3.3.5. Attach fabric to end and corner posts with tension bars and tension bar clips.
  - 3.3.6. Install bottom tension wire stretched taut between terminal posts.
  - 3.3.7. Brace each gate and corner post to adjacent line post with horizontal center brace tail and diagonal truss rods. Install brace tail, on bay from end and gate posts.
  - 3.3.8. Install each gate leaf with fabric fence. Install hardware specified and as required by the manufacturer.
- 3.4. Erection Tolerances:
- 3.4.1. Maximum variation from plumb: 1/4 inch.
  - 3.4.2. Maximum offset from true position: one inch.

END OF SECTION

## SECTION 32 80 00

### UNDERGROUND IRRIGATION SYSTEM

#### PART 1 - GENERAL

##### 1.1 SCOPE

- A. All work specified in this section and indicated on the plans shall be accomplished for the purpose of providing a landscaping development irrigation system complete. The work includes, but is not limited to design and providing the irrigation system with required electronic controls and switches for synchronized operation throughout the irrigation system. The irrigation system shall provide complete coverage for the front lawn areas indicated in the drawings. Irrigation shall not be provided for the shrubs and plant areas around Buildings 2 and 4.

##### 1.2 APPLICABLE DOCUMENTS

- A. In addition to the general provisions and conditions herein, including but not limited to General, Supplementary, Special and/or Addenda Conditions and any other General Requirements herein, the following documents, specifications and standards form a part of this specification to the extent required by the reference thereto. The latest edition of publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

- B. AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME):

- 1. B16.18-1984 Cast Copper Alloy Solder Joint Pressure Fittings
- 2. B16.22-1995 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
- 3. B16.2-B16.5 Galvanized Steel Pipe and Fittings

- C. AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

- 1. ASSE 1003 Performance Requirements for Water Pressure Reducing Valves (for Domestic Water Supply Systems)
- 2. ASSE 1010 Performance Requirements for Water Hammer

## Arrestors

### D. American Society of Testing Materials (ASTM):

1. B 32 Specification for Solder Metal.
2. B 88 Specification for Seamless Copper Water Tube
3. D 1527 Specification for Acrylonitrile - Butadiene - Styrene (ABS) Plastic Pipe, Schedules 40 and 80
4. D 1785 Specification for Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120
5. D 2466 Specification for Poly(vinyl chloride) (PVC) Plastic Pipe Fittings, Schedule 40
6. D 2468 Specification for Acrylonitrile - Butadiene-Styrene (ABS) Plastic Pipe Fittings, Schedule 40
7. F 645 Guide for Selection, Design, and Installation of Thermoplastic Water Pressure Piping Systems
8. F 690 Practice for Underground Installation of Thermoplastic Pressure Piping Irrigation Systems

### E. AMERICAN WATER WORKS ASSOCIATION (AWWA)

1. AWWA C500 Standard for Gate Valves for Water and Sewerage Systems
2. AWWA C509 Standard for Resilient-Seated Gate Valves for Water and Sewerage Systems

### F. MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

1. MSS SP-70 Cast Iron Gate Valves, Flanged and Threaded Ends
2. MSS SP-80 Bronze Gate, Globe, Angle and Check Valves
3. MSS SP-110 Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

### G. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

1. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum)

H. Underwriters' Laboratories: All electrical equipment and supplies to be incorporated into the work.

I. Landscape Ordinance of local jurisdictional government or agency.

### **1.3 SUBMITTALS**

A. Shop Drawings: Shop drawings and manufacturer's performance and specification literature shall be submitted for all specified materials in accordance with the General Conditions.

B. Written Guarantee: Submit a written guarantee for one full year against defects and malfunctions in equipment and against faulty workmanship. Guarantee shall state the name of the Owner, provide full guaranty terms, effective and termination date, name of Contractor providing guarantee and address and telephone number of Contractor providing guarantee. It shall be signed by the chief executive of the company and notarized.

### **1.4 PRODUCT HANDLING, DELIVERY AND STORAGE**

A. General: The delivery and storage of materials, equipment and supplies shall be coordinated with the Owner's representative. Storage shall not be commingled with products of other trades or Contractor-Subcontractors who may be on the job site.

B. Condition of Materials, Equipment and Supplies: Upon delivery the equipment, materials and supplies to be incorporated into the work shall be in new and unused condition and in manufacturer's cartons or other satisfactory containers or wrappers. Where units of the system are prefabricated away from the job site, these same conditions and limitations shall apply.

C. Handling: All equipment, materials and supplies shall be handled in a careful and protective manner to disallow impairment of nozzle openings threads, pipe ends, wiring and control pins and other features of the materials.

D. Protection and Security of Stored Materials: The Contractor/Subcontractor shall be responsible for the protection and security of stored materials at all times, whether on or off the site.

### **1.5 JOB CONDITIONS AND QUALITY CONTROL**

A. Examinations: The Contractor/Subcontractor who will perform the work

specified in this section and detailed on the plans must examine the work site and all interrelated construction documents, including, but not limited to, the complete and thorough reading of this specification.

- B. Precedence and Completion of Work: The work under this section shall be scheduled in close coordination with other trades and with approval of the Owner's representative. It is especially important to complete irrigation work ahead of landscape plantings. When properly coordinated this may be done on a zone by zone basis, depending upon the area(s) to be planted.
- C. Utilities and Underground Objects: Determine the location of all underground utilities and other objects and perform work in a manner which will avoid damages. Damages shall be repaired in a manner approved by the Owner and shall be fully completed before inspection and acceptance.
- D. Qualifications of Contractor: The work specified in this division and detailed on the drawings shall be performed by a Contractor/Subcontractor who is primarily engaged in the construction of irrigation systems and who has been so engaged for a minimum period of three (3) consecutive years most recently passed.
- E. Qualifications of Manufacturer: The manufacturer of the equipment and supplies incorporated in the work shall have been engaged in such manufacture for not less than five (5) years, shall have a national distribution and service network and shall be approved by the Landscape Architect.
- F. Source Quality Control: All materials and products shall comply with the minimum applicable test and acceptance standards of ASME and ASTM, all as referenced hereinbefore.

## 1.6 GUARANTY

- A. The Contractor shall submit the following written and signed guaranty to the Owner:

### GUARANTY

The undersigned fully guarantees the irrigation system and all of its components and workmanship against defect and failure, except when such defect or failure results from inflicted damage, for one full year from the date of Owner acceptance. The undersigned likewise guarantees that the system and its components have been properly, correctly and safely installed and in substantial compliance with the Contract Documents. The undersigned further guarantees that all warranty work will be performed within twenty-four (24) hours of telephone notification.

General Contractor

Installer/Owner

\_\_\_\_\_  
Signed

\_\_\_\_\_  
Signed

\_\_\_\_\_  
Title

\_\_\_\_\_  
Title

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. Materials and equipment of approved equivalents shall be as shown on the plans. All materials and equipment to be incorporated into the work shall be new and unused.

### **2.2 VALVES**

- A. Valves of the manual type shall have non-rising stems, screwed bonnet, disc wedge of the replaceable type, bronze body construction throughout and shall meet standards of the AWWA and MSS hereinbefore referenced for Class "A" valves.
- B. Remote controlled valves shall be electronically operated, normally closed, 24 volt, 1 ampere, constructed of cycloc ABS plastic and stainless steel, capable of manual operation and shall have the valve body constructed of ABS plastic with accurately machined seat faces and with female pipe threads or with bolted flanged connections depending upon valve size. The valve shall be self-flushing. The motor assembly shall be easily removable from the valve body without removing valve body from the throttling device for system balancing. Throttling of the valve shall not affect the speed of opening or closing.

The valve shall be pre-wired by the manufacturer with sufficient extended wiring for easy secure connection. Valve shall comply with all code and permitting requirements and shall be compatible with the automatic controller for the system.

### **2.3 PIPE**

- A. All piping for the irrigation system shall be Schedule 40, PVC (Polyvinyl Chloride), normal impact, type 1, meeting ASTM standards as hereinbefore referenced. Solvent weld joint type.
  - 1. Risers: Schedule 40 Polyvinyl Chloride (PVC) shall be used for risers unless otherwise on the plans. All risers shall be painted olive green.

Painting shall apply to all portions of the systems which rise above the ground. Paint shall be flat enamel or acrylic for application to PVC and other surfaces.

2. Fittings: Schedule 40 PVC or approved equivalent fittings shall be used for all PVC piping installations. Fittings for galvanized pipe work shall be Schedule 40 galvanized steel.

#### **2.4 ANTI-SIPHON DEVICE**

- A. Provide a double check valve assembly meeting ASSE Standard 1015 with ancillary valves and fittings as detailed on the plans. The anti-siphon device shall be constructed of an all brass body and shall withstand water temperature of 212°F. The main device shall be installed 12 inches above grade. It shall be located and situated in the least visible and most unobtrusive position and shall be painted olive green as hereinbefore specified for risers.

#### **2.5 SPRINKLER HEADS**

- A. Furnish and install the type and kind of sprinkler heads noted and designed on the plans. Comparable types and kinds of other manufacturers may be submitted for consideration and may be used when approved.

#### **2.6 WIRING**

- A. Electrical wiring to energize valves and to connect the pump starter, if a pump or pumps is part of the system, and the controller shall be "UL" listed. Wire for valves shall be type "UF" or "THW" for underground burial, rated for 600 volts, copper clad with rubber or approved sheathing, single stranded, and not less than #14 AWG in size.

#### **2.7 CONTROLLER**

- A. Provide Hunter Model IC-600SS 6 station controller expandable to 42 stations with stainless steel cover. It shall be wall or pedestal mounted as may be required. UL listed and shall have a locking metal cover and hasp. Install and connect with the automatic valves as designed in the system. Locks shall be furnished for the cabinets and shall be keyed alike. Six (6) keys for the locks shall be furnished to the Owner. Controller to be provided by the Owner. Contractor shall make all necessary connections.
- B. Operating Specifications:
  1. Station Run Time: 1 minute to 12 hours (in 1-minute increments) on programs A, B, C, D.
  2. Start Times: 8 per day, per program (A,B,C), 16 per day (D) for up to 40 daily starts.
  3. Watering Schedule: 7-day calendar, interval watering up to a 31-day interval or true odd or even day programming, made possible



by the 365-day clock/calendar.

C. Electrical Specifications

1. Transformer Input: 120 VAC, 60Hz (230 VAC, 50/60 Hz International Use).
2. Transformer Output: 25 VAC, 1.5 amp
3. Station Output: 24VAC, 0.56 amps per station
4. Maximum Output: 24 VAC, 1.4 amps (includes Master Valve Circuit)
5. Battery Backup: 9-volt alkaline battery (not included) used only for time keeping during power outages, the nonvolatile memory maintains program information.

**2.8 STAKES**

- A. Stakes for securing above ground risers shall be ½-inch electrical metallic tubing driven to a depth of three (3) feet and extending to 2/3 riser height. Paint stakes according to riser painting requirements.

**2.9 MISCELLANEOUS PRODUCTS**

- A. Products or materials and supplies for mounting, connecting and fully completing the irrigation system and which may not be noted on the plans and/or described herein shall be furnished and installed as new and unused and shall comply with all codes and permitting requirements. Such products, materials or supplies shall constitute a part of this specification just as though they were enumerated herein.

**PART 3 - EXECUTION**

**3.1 LAYOUT LOCATION**

- A. Each sprinkler head and irrigation valve location shall be marked with surveyor's grade line flags for determination of potential conflicts. Upon determining that each location is proper and that said location will provide the desired and required coverage the work may proceed. Should the Contractor determine that proper coverage cannot be obtained, the Architect shall be notified before work commences. Most applicable requirements of ASTM F 690.

**3.2 EXCAVATION AND BACKFILL**

- A. All trenching and excavating shall be done in careful regard for underground utilities and structural elements. Owner's representative to inspect the jointed pipe. Failure of the Owner's representative to inspect the pipe before allowing the Contractor/Subcontractor to backfill shall not constitute any waiver of the Contractor's /Subcontractor's responsibility and liability for guaranty or failure of the piping system. When approved, backfill shall be placed and tamped in six (6) inch layers. Such backfill shall be clean, friable soil, without lumps and

the presence of debris. Excavation shall be to minimum depth of eighteen (18) inches, or as detailed on the plans, whichever is greater. Defacements, stains, damages and destruction of other work shall be repaired or replaced in a manner satisfactory to the Owner.

### **3.3 PIPE DEPTHS**

- A. Pipe shall be buried to minimum depth of eighteen (18) inches, or as shown on the plans, whichever is greater. Six (6) inches of clearance shall be provided horizontally for lines in the same trench. Comply with local code if such code is more stringent than this requirement.

### **3.4 PIPE PLACEMENT LONGITUDINALLY**

- A. Insure that pipe is laid loosely to allow for coefficient of expansion and contraction. Pipe shall be laid in center of trench and to the bottom of the trench. It shall be placed to clear plant holes and tree pits by twelve (12) inches, except in locations where ground covers are bed planted.

### **3.5 HEADS**

- A. Attach heads and set according to the manufacturer's instructions and as detailed and noted on the plans.

### **3.6 FLUSHING**

- A. Pipe lines shall be thoroughly flushed after entire zone has been completed and before nozzles are inserted in heads. Erosion of plant beds and adjacent areas shall be restored and repaired.

### **3.7 THRUST BLOCKING**

- A. As noted on the plans thrust blocking shall be installed at all points where piping system changes direction. Such blocking shall not be less than two (2) cubic feet of 2,500 psi ready mix concrete. It shall be poured to encircle and to buttress the pipe against water hammer and hydraulic thrust.

### **3.8 VALVE BOXES**

- A. Provide and install valve boxes as noted and detailed on the plans for all valves throughout the system. Boxes shall be affixed with a cover marker inscribed to read "Sprinklers" or "Irrigation."

### **3.9 AUTOMATIC CONTROLLER**

- A. Install the electronic controller in the location noted on the plans. Such

controller shall be fully energized, securely wall mounted at the height noted in the drawing notes in a weatherproof and locking metal case as provided by the manufacturer.

**3.10 TESTING AND BALANCING**

- A. Each zone shall be separately tested and balanced for coverage and performance in the presence of the Owner's representative. Acceptance at final inspection shall be disallowed unless this has been done satisfactorily.

**3.11 PROTECTION**

- A. It shall be the responsibility of the Contractor /Subcontractor to protect and secure the work site until the Owner accepts the work.

**3.12 JOINT TEST**

- A. Prior to covering each jointed location in the piping system the Contractor shall cap each outlet or discharge point and shall turn on the water supply for a minimum period of one hour to determine if leakage is occurring. Each joint shall be inspected by the Contractor and may be covered after it is determined that the joint is sufficient after one hour of testing. The Landscape Architect may require sample joints to be uncovered for his inspection without additional cost to the Owner, the Landscape Architect and/or the project.

END OF SECTION



## SECTION 32 92 00

### GRASSING, SEEDING AND SODDING

#### 1. GENERAL:

- 1.1 RELATED DOCUMENTS: The General Provisions of the Contract, including the General Conditions, Supplementary Conditions and Special Conditions (if any), along with the General Requirements, apply to the work specified in this Section.
- 1.2 SCOPE: The work specified in this Section consists of the establishing of a stand of grass within the areas disturbed by construction, or otherwise described on the drawings, and maintaining such areas until completion and final acceptance of the project. The methods specified herein are grassing by seeding and grassing by sodding.
- 1.3 JOB CONDITIONS:
  - 1.3.1 Sodding: It is the intent of this section that all areas disturbed by construction and to remain unimproved by hardscape shall be stabilized with sod.
  - 1.3.2 Seeding: Seeding shall be required by the Engineer for temporary erosion control at his discretion.
- 1.4 SUBMITTALS:
  - 1.4.1 Seed Mix: Manufacturer's warranted analysis for percentages of mixture, purity and germination.
  - 1.4.2 Sod Suppliers statement certifying origin and health of sod.
  - 1.4.3 Sod Supplier's recommended fertilizer application rates.
  - 1.4.4 Soil Test Results and soil amendment recommendations.
  - 1.4.5 Fertilizer: Manufacturer's literature and data describing NPK ratio and recommended application rates.
  - 1.4.6 Pre-emergent Herbicide: Manufacturer's literature and data describing proposed chemical and compatibility with grassing products.

1.5 QUALITY CONTROL:

- 1.5.1 All work in this section shall be in accordance with Section 570-1 through 570-4 of the FDOT Standard Specifications (Latest Edition) for Road and Bridge Construction, except as modified herein.
- 1.5.2 All grassing operations shall provide a thick and vibrant covering of disturbed areas by final completion of the work. The requirement for adequate growth and coverage shall not be waived due to seasonal influences.
- 1.5.3 The Contractor shall be responsible for scheduling the work to ensure grass has adequate time to take hold and to adjust mixes (with Engineer's approval) to meet the quality assurance standards required by this Section.
- 1.5.4 Soil samples shall be taken and analyzed by a local extension office for pH, lime requirements and available nutrients (P, K, Ca, Mg).

2. MATERIALS:

2.1 FERTILIZER:

- 2.1.1 For bidding purposes, the fertilizer shall be considered 6-15-15 which has a chemical analysis as follows:

Total Nitrogen:	Not less than 6%
Available Phosphoric Acid:	Not less than 15%
Water-Soluble Potash:	Not less than 15%

- 2.1.2 All fertilizer shall comply with state and local laws and regulations and shall be fully labeled at the time of delivery to the job site.
- 2.1.3 Lime and pH adjustment shall be dependant on the results of the Soil Analysis. Contractor shall amend soil as required to conform to the soil analysis.

2.2 SEED MIXTURE:

- 2.2.1 Unless other types of seed are called for, seed shall be a mixture of twenty (20) parts of hulled Millet seed and eighty (80) parts of Bermuda seed thoroughly dry mixed immediately before sowing.
- 2.2.2 Seed germination rates shall be as follows:
  - 1. Bermuda Grass Seed shall be of common variety with a minimum pure seed content of 95 percent with a minimum germination of 85 percent.

2. Annual Type Rye Grass Seed shall have a minimum pure seed content of 95 percent with a minimum germination of 90 percent.
- 2.2.3 Seed which has become wet or moldy shall not be used.
- 2.2.4 During the period from October 15 to February 15, rye grass seed shall be added and thoroughly dry mixed with the regular mixture at the rate of twenty (20) pounds rye seed per one hundred (100) pounds of regular seed mixture.
- 2.3 MULCH: The mulch shall consist of Milet, Rye, or Bahia straw. Other types of mulch may be used only when approved by the Engineer.
- 2.4 SOD:
  - 2.4.1 Types:
    1. Generally, sod shall be Common Bermuda Grass in all typical applications and in non-maintained areas.
    2. Where proposed sod abuts other established stands of grass the Engineer or his representative may, at his discretion, require the Contractor to match the existing grass for all or a portion of the abutment. No additional compensation shall be allowed for providing other sod types.
  - 2.4.2 The sod shall be taken up in commercial-size rectangles, preferably 12 x 24 inches or larger, or continuous rolls. The sod shall be sufficiently thick to secure a dense stand of live grass. The sod shall be green, live, fresh, and uninjured, at the time of planting. It shall have a soil mat of sufficient thickness adhering firmly to the roots to withstand all necessary handling. It shall be reasonably free of weeds and other grasses. It shall be planted as soon as possible after being dug and shall be shaded and kept moist from the time it is dug until it is planted. The source of the sod may be inspected and approved by the Engineer prior to being cut for use in the work. After approval, the area from which the sod is to be harvested shall be closely mowed and raked as necessary to remove excessive top growth and debris.
  - 2.4.3 Approved devices, such as sod cutters, shall be used for cutting the sod and due care shall be exercised to retain the native root soil intact.
- 2.5 WATER: The water shall be free of excess and harmful chemicals, acids, and alkalies or any substance which might be harmful to plant growth or obnoxious to traffic. Salt water shall not be used. The Contractor shall make all arrangements for obtaining and transporting water to the job site. All grassing shall be watered until grass is well established at the Contractor's expense.

2.6 PRE-EMERGENT HERBICIDE:

2.6.1 Selective type pre-emergence control chemical suitable for use under the proposed grass or landscaped surface.

2.6.2 Application personnel shall be certified in the State of Florida for application of agricultural chemicals.

3. INSTALLATION:

3.1 SCHEDULE: Grass shall be in place by substantial completion of the project.

3.2 PREPARATION OF GROUND:

3.2.1 Final grading and cleaning shall be completed prior to preparation of ground for grassing. Sod installer is not responsible for final grades, but shall not lay sod on soil that has not been properly prepared or is obviously damaged by erosion or heavy equipment, etc.

3.2.2 The areas to be grassed shall be scarified or loosened to a depth of at least six (6) inches.

3.2.3 All areas shall be smooth and free of large clods, roots and other materials which may interfere with the work or future mowing and maintenance operations.

3.2.4 No subsequent operations shall be commenced until the Engineer, or designated representative, has approved the condition of prepared areas.

3.2.5 Areas receiving specialty grassing such as Athletic Fields, shall be treated with a pre-emergent herbicide in accordance with chemical manufacturer's and grassing supplier's instructions.

3.2.6 Fertilizer, pH and Lime adjustments shall be spread and mixed in accordance with these specifications and the grass supplier's recommendations and the soil analysis.

3.2.7 Sod shall not be laid on soil too hot to receive new grass. If in question the Contractor shall lightly water the exposed soil and keep soil damp until sod is laid.



### 3.3 APPLICATION:

#### 3.3.1 Fertilizer and soil amendments:

1. As a minimum, Commercial fertilizer shall be spread uniformly over the area to be grassed at the rate of twenty (20) pounds per one thousand (1000) square feet or as recommended by the Grassing Supplier. No additional payment shall be made to achieve grass supplier's and soil analysis recommended fertilizer spread rate. Soil amendments shall include Lime and pH adjustments in accordance with the Soil Analysis.
2. Immediately after the fertilizer and other soil amendment are spread, it shall be raked in and thoroughly mixed with the soil to a depth of approximately two (2) inches.
3. Refertilize approximately sixty (60) calendar days after initial application if project has not been accepted prior to this time.

#### 3.3.2 Seeding: Where required, Seeding shall be done immediately after fertilizing, while the soil is still loose and moist. The seed shall be scattered uniformly over the area to be grassed by a mechanical spreader or other approved type of spreader.

1. Mechanical Spreader:
  - a. Sow  $\frac{1}{2}$  seed in one direction and sow remainder at right angles to the first sowing.
  - b. Seeded areas shall be harrowed, raked, or otherwise worked to ensure seed is covered by soil.
  - c. After seeding firm entire area with appropriate rolling equipment or cultipacker.

#### 3.3.3 Mulch:

1. Immediately after completion of mechanical seeding, dry mulch shall be uniformly applied over the seeded area approximately one inch (1"), loose thickness.
2. The mulch shall then be cut uniformly into the soil so as to produce a loose mulched thickness of two inches (2") and rolled with a cultipacker, traffic roller or other suitable equipment.

3. After seeding and mulching is completed, the entire area shall be watered so as to provide optimum growth conditions for establishment of the grass.

#### 3.3.4 Placement of Sod:

1. Sod shall be laid immediately after the application of the fertilizer.
2. Sodding shall be incorporated into the project at the earliest practical time in the life of the Contract, but no later than project substantial completion.
3. No sod which has been cut for more than seventy-two (72) hours shall be used unless specifically authorized by the Engineer, or his representative, after his careful inspection thereof.
4. Any sod which is not planted within twenty-four (24) hours after cutting shall be stacked in an approved manner and maintained properly moistened.
5. Sodding shall not be performed when weather and soil conditions are, in the Engineer's opinion, unsuitable for proper results.
6. The sod shall be placed on the prepared surface, with edges in close contact, and shall be firmly and smoothly embedded by rolling with approved roller.
7. Where sodding is used in drainage ditches, the setting of the pieces shall be staggered, such as to avoid a continuous seam along the line of flow. Along the edges of such staggered areas the offsets of individual strips shall not exceed six inches (6"). In order to prevent erosion caused by vertical edges at the outer limits, the outer pieces of sod shall be tamped so as to produce a featheredge effect.
8. On areas where the sod may slide, due to height and slope, the Engineer may direct that the sod be pegged, with pegs driven through the sod blocks into firm earth, at suitable intervals. Any pieces of sod which, after placing, show an appearance of extreme dryness, shall be removed from the work.
9. Ponds shall be stabilized with sod as follows:
  - a. Dry Retention Pond
    - 1) All banks
    - 2) Ten feet beyond top of bank
    - 3) Pond bottom

- b. Wet Detention Pond
  - 1) All pond banks to water elevation at time of sod placement.
  - 2) Ten feet beyond top of bank

10. All swales shall be sodded top of bank to top of bank.

3.3.5 Watering of Grassed Areas: The grassed areas shall be watered for the duration of the Contract so as to provide optimum growth conditions for the establishment of the grass. The water used shall be obtained from the construction well or other means at the Contractor's expense.

3.3.6 All areas of sod installation shall be rolled to remove bumps and ruts. The tolerance for acceptance of finished surfaces shall be as described in 02300 Earthwork.

#### 3.4 MAINTENANCE OF GRASSED AREAS:

3.4.1 The Contractor shall, at his expense, maintain the planted areas in a satisfactory condition until Final Acceptance of the Project. Such maintenance shall include:

- 1. Watering and mowing of all grassed areas.
- 2. Filling, leveling, grading, repairing and regrassing of any washed or eroded areas, as may be necessary.
- 3. Refertilization of areas maintained more than 60 days beyond installation.

#### 3.5 ACCEPTANCE:

3.5.1 All turf must be established upon final acceptance of the work. Established shall mean:

- 1. Grass is rooted (leaves break before plant separates from soil).
- 2. No bare spots greater than 1 SF.
- 3. No deformation of grass due to Contractor equipment or erosion.
- 4. No obviously diseased, infested, or dead zones.
- 5. No exposed sod netting.
- 6. No noxious weeds.

3.5.2 Areas in which the establishment of the grass is not achieved, due to disease, infestations, bare spots or dead zones, shall be removed and replaced. All other areas shall be repaired in place prior to final payment.

3.5.3 If a planted area must be replanted, replacement shall be at the Contractor's expense.

3.6 CLEANUP: All excess materials associated with this activity shall be removed from the site. Site shall be left in a neat and tidy condition, free from trash and debris.

END OF SECTION

## SECTION 33 05 13

### PRECAST CONCRETE MANHOLES

#### 1. GENERAL:

1.1 DESCRIPTION OF WORK: The work under this section shall include the furnishing of all labor, materials and equipment necessary for the construction and installation of all manholes and drainage structures as called for on the drawings.

#### 1.2 QUALITY ASSURANCE:

1.2.1 Manufacturer of precast concrete covered in this section shall have a minimum of 5 years experience in the design and construction of wire wound circular precast structures.

1.2.2 Manufacturer of top and frames specified herein shall have a minimum of five years experience in the manufacture of like product.

#### 1.2.3 Submittals:

1. Provide shop drawings showing dimensions, finishes, reinforcement and connections details.
2. Provide erection layout and details.
3. Provide cut sheets of catalog cuts and details of all accessories.
4. Provide test results for concrete.

1.2.4 Standards: Latest edition of the Florida Department of Transportation Standard Specification for Bridge and Roadway Construction.

1.2.5 PRODUCT DELIVERY AND HANDLING: Handle and store materials to prevent damage and deterioration.

#### 2. PRODUCTS:

2.1 PRECAST CONCRETE MANHOLES: Manhole bases, sections and cones shall conform to the requirements of ASTM C478, Specification for Precast Reinforced Concrete Manhole Sections with the exception of Section 10 (a), except as modified herein. Cement shall meet the requirements of ASTM C150, Specification for Portland Cement, Type II. Concrete shall have a minimum compressive strength of 4,000 psi. Minimum wall thickness shall be 1/12 the inside diameter in inches plus one inch. The required minimum strength of concrete shall be confirmed by making

and testing four standard cylinders at seven days. Rings shall be custom-made with openings to meet indicated pipe alignment conditions and invert elevations.

2.1.1 Bases: Bases for manholes shall be cast integrally with the bottom manhole section. The base section shall be set in a 2-inch leveling course of Class C concrete poured directly on the prepared subgrade as shown on the drawings. In order to permit adjustment of the precast base section and insure full bearing on the leveling course, said section shall be placed just prior to initial set of the Class C concrete leveling course.

2.1.2 Joints: Joint contact surfaces shall be formed with machined castings; they shall be exactly parallel with 2 degree slope and nominal 1/16-inch clearance with the tongue-equipped with a proper recess for the installation of an O-ring rubber gasket, conforming to ASTM C443, Joints for Circular Concrete Sewer and Culvert Pipe Using Rubber gasket, or RAMNEK premolded Plastic Joint Sealer with joints preprimed.

2.1.3 Coating: With the exception of joint contact surfaces, and the interior surfaces of all openings to receive the pipe and a one inch annular ring around the interior and exterior of said openings, the interior and exterior surfaces of each manhole shall be given two coats of Farbertite as manufactured by Briggs Bituminous Composition Company, Philadelphia, Pa., a subsidiary of Penn Crete Products Co., Inc.; no substitutes. Total minimum dry film thickness shall be 12 mils. Each coat shall be applied at a rate not to exceed one gallon per 100 square feet. The waterproofing materials shall be applied by brush or spray and in accordance with the instruction of the manufacturer. Time shall be allowed between coats to permit sufficient drying so that the application of the second coat has no effect on the first coat. Special precaution shall be taken not to coat joint contact surfaces, as Farbertite is not a joint prepriming material.

2.1.4 Manhole Adjustment Materials:

1. Bricks: The brick shall be sound, hard and uniformly burned brick, regular and uniform in shape and size, of compact texture and satisfactory to the Engineer. Brick shall comply with the ASTM Standard Specifications for Sewer Brick (Made from Clay or Shale), Designation C-32, latest, Grade MM. Each brick shall be laid in a full bed and joint of mortar without requiring subsequent grouting, flushing, or filling, and shall be thoroughly bonded as directed. Only clean brick shall be used in brickwork. The bricks shall be moistened by suitable means, as directed, until they are neither so dry as to absorb water from the mortar, not so wet as to be slippery when laid. Outside faces of brick masonry shall be plastered with mortar from 1/4-inch or 3/8-inch thick. If required, the masonry shall be properly moistened prior to application of the mortar. The plaster shall be

carefully spread and troweled so that all cracks are thoroughly worked out. After hardening, the plaster shall be carefully checked, by being tapped, for bond and soundness. Unbound or unsound plaster shall be removed and replaced. Brick masonry and plaster shall be protected from too rapid drying by the use of burlaps kept moist, or by other approved means, and shall be protected from the weather and frost.

2. Rejected brick shall be immediately removed from the work and brick satisfactory to the Owner substituted.
3. Mortar for Brickwork: The mortar shall be composed of portland cement and sand. Mortar shall be one part cement and two parts sand; lime shall not be used.
4. Cement: Portland, ASTM C150, Specification for Portland Cement, Type II.
5. Sand: Washed silica sand, ASTM C144, Specification for Aggregate for Masonry Mortar.
6. Non-shrink Mortar: Embeco No. 167 and No. 381 Mortar as manufactured by the Master Builders Co. rapid drying by the use of burlaps kept moist, or by other approved means, and shall be protected from the weather and frost.

2.1.5 CAST IRON FRAMES, GRATINGS AND COVERS: Castings shall be made of good quality, strong, tough, even grained cast iron and shall be smooth, free from scale, lumps, blisters, sandholes and defects of any nature which would render them unfit for the service for which they are intended. They shall be thoroughly cleaned and subjected to a careful hammer inspection. Castings shall meet the requirements of ASTM A48-64, Specifications for Gray Iron Castings, Class No. 30, or Grade 65-45-12, Ductile Iron meeting the requirements of ASTM A536-70, Standard Specification for Ductile Iron Castings. In either case, manhole frame and cover shall be designed to withstand an HS20-44 loading defined in the AASHTO Specifications. Frames and covers shall be machined or ground at touching surfaces so as to seat firmly and prevent rocking. Any set not matching perfectly shall be removed and replaced at no additional cost.

2.1.6 FLEXIBLE MANHOLE CONNECTOR: Where the sewer pipe enters the precast manhole, a flexible pipe to manhole connector shall be used. The connector shall be the "Kor-N-Seal" as manufactured by National Pollution Control Systems, Inc., Milford, New Hampshire or equal. The connector shall be the sole element to assure a flexible watertight seal of the pipe to the manhole.

- 2.1.7 Material: The Neoprene-EPDM material the connector is manufactured from shall conform to ASTM C-443 and shall be a minimum of 3/8 inches (9.4MM) thick or greater. The material shall be resistant to ozone, weathering, aging, chemicals, including acids, alkalis, animal and vegetable fats, oils and petroleum products.
- 2.2 BANDS: The stainless steel band and worm screw assembly shall be totally non magnetic series 304 stainless steel. The worm screw for tightening the stainless steel band shall be torqued by a break-away torque wrench available from the precast manhole supplier and set for a torque pressure of 60-70 inch/pounds.
- 2.3 CONNECTOR: The connector shall be of a size specifically designed for the specified pipe material and size. Also, the connector shall be installed in the manhole wall by the precast manufacturer in strict accordance with the recommendations of the connector manufacturer. During the invert construction stage, the interior annular space between the exterior of the pipe and the interior of the connector shall be filled with a Type II Lean Cement Grout by the Contractor.
- 2.4 WATERTIGHT POLYETHYLENE MANHOLE INSERT: Each manhole which is not installed in a paved road, where the top of the manhole lid is to be buried below grade, shall be fitted with a watertight manhole insert to prevent the intrusion of groundwater or rainwater. The manhole insert shall be constructed of rust-free, high density polyethylene and shall be shaped to allow the manhole cover to swing freely. The insert shall be furnished with a gasket, heat-welded to the liner, to help seal the manhole cover. The liner shall be furnished with a spring-loaded gas relief valve designed to relieve sewer gas at ½ psi. The liner shall also be furnished with a spring-loaded vacuum relief valve designed to release vacuum in the collection system at 2.25 psi. Both valves shall be constructed of non-corrosive materials and shall be sturdy enough to act as handles to remove the liner. Acceptable: Sewer Guard Manhole Insert by Fasroc, Inc. or equal.

### 3. INSTALLATION:

- 3.1 INSTALLING SECTIONS: Precast concrete sections shall be set so the manhole will be vertical and with sections in true alignment. Joint surfaces of the base of previously set section shall have an O-ring installed in the recess or shall be sealed with pre-molded plastic joint sealer "RAMNEK." If "RAMNEK" is used, joints shall be pre-primed.
- 3.2 METALLIC NON-SHRINK MORTAR: All holes in sections used for their handling, and the annular space between the wall and entering pipes shall be thoroughly plugged with Embeco No. 167, or No. 381 as manufactured by the Master Builders Company, or Thoroset (RM) as manufactured by the Standard Dry Wall products Inc., or any approved equal non-shrinking mortar or grout, applied and cured in strict conformance with the manufacturer's recommendations, so that there will be zero leakage through openings and around pipes. The mortar shall be finished smooth and flush with the adjoining interior and exterior manhole wall surfaces.



- 3.3 MEMBRANE CURING COMPOUND: As soon as mortar is hydrated to the point where it will not be marred by such application, and within two (2) hours after installing mortar, the Contractor shall apply an approved membrane curing compound, conforming to ASTM C-309-74, Type 1, Class B, to the finished mortar surfaces both inside and outside the manhole. Embecco mortar shall be coated with Master Builder's Masterseal; Thoroset (RM) grout shall be coated with Standard Dry Wall Products' Thorocure. Submission of alternate mortars or grouts should include an alternate membrane curing compound or indicate which of the above approved products is proposed for use.
- 3.4 GRADE ADJUSTMENT: For grade adjustment in setting the manhole frame, brick masonry shall be used on top of manhole slabs and precast concrete manhole cones in accordance with the drawings. Mortar shall be one part cement and two parts sand; lime shall not be used.
- 3.5 SETTING MANHOLE FRAMES: Manhole frames and covers shall be set to conform accurately to the finished ground or pavement surface as established by the Contract Drawings, unless otherwise directed by the Owner. Frames on manhole cones shall be set concentric with the masonry and in a full bed of mortar so that the space between the top of the manhole masonry and the bottom flanges of the frame shall be completely filled and made water tight. A ring of mortar at least one inch thick and pitched to shed water away from the frame shall be placed around the outside of the bottom flange. Mortar shall extend to the outer edge of the masonry and shall be finished smooth and flush with the top of the flange.
- 3.6 FLOW CHANNELS: Flow Channels in manhole base shall be formed of Class "C" concrete and/or brick rubble and mortar, while the manholes are under construction. Cut off pipes at inside face of the manhole and construct the invert to the shape and sizes of pipe indicated. All inverts shall follow the grades of the pipe entering the manholes. Changes in direction of the sewer and entering branch or branches shall be laid out in smooth curves of the longest possible radius which is tangent to the centerlines of adjoining pipelines.
- 3.7 CLEANUP: The Contractor shall maintain the site of the work in a neat condition. The Contractor shall remove all excess materials, excess excavated materials and all debris resulting from his operations.

END OF SECTION



## SECTION 33 05 23

### DIRECTIONAL DRILL

#### 1. GENERAL

1.1 DESCRIPTION: Work under this section of the specifications consists of furnishing all materials, labor and equipment and performing all operations in connection with the installation of the underground utilities using the Horizontal Directional Drilling (HDD) installation method, also commonly referred to as a Directional Bore or Directional Drill. This work shall include all services, equipment, materials, and labor for the complete and proper installation, testing, and restoration of underground utilities.

#### 1.2 QUALITY ASSURANCE:

1.2.1 The requirements set forth in this Specification specify a wide range of procedural precautions necessary to insure that the very basic, essential aspects of a proper Directional Bore installation are adequately controlled. Strict adherence shall be required under specifically covered conditions outlined in this Specification.

1.2.2 Adherence to the specifications contained herein, or the Engineer's approval of any aspect of any Directional Bore operation covered by this Specification, shall in no way relieve the Contractor of their ultimate responsibility for the satisfactory completion of the work authorized under the Contract.

1.2.3 The Directional Drilling subcontractor shall have been in business for a minimum of three (3) years and shall have successfully completed a minimum of ten (10) other drills which utilized pipe both at least 12" in diameter and 500' long.

1.2.4 In order to unify responsibility for proper operation and service of the directional drill, it is the intent of these Specifications that all system components, labor, and equipment shall be furnished by a single subcontractor (unitary source).

#### 1.3 SUBMITTALS:

1.3.1 Prior to beginning work, the Contractor must submit to the Engineer a report of the procedure and equipment to be used on the project. The report will insure that no drilling mud pits shall be used and that drilling mud from the bore hole shall be continuously removed with a vac truck.

1. A list of equipment expected to be used for the Directional Bore, including special equipment and materials required for various soil conditions.
  2. Time schedule for completing each Directional Bore, including any delays due to particular soil conditions.
  3. Qualifications of the subcontractor and certification of the pipe welders.
  4. The Contractor shall provide written verification of existing utility locations, both horizontal and vertical, that are located within the drill path. Utilities shall be located in accordance with ASCE Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data (CI/ASCE 38-02), Quality Level A.
  5. The Contractor shall provide a conceptual drill path routing based on information obtained through Task 4 and provide documentation of all drilling entry and exit point considerations. All work shall be completed within FDOT right-of-way, Town right-of-way, or acquired easements. If a profile is not shown within the Drawings, the minimum clearance beneath all roadways shall be 10 bore diameters.
  6. Environmental Protection Plan: Contractor shall provide an erosion and control plan for all drilling operations and any drainage, wetland, waterway, or other area designated for such protection by contract documents, state, federal, and local regulations. Contractor shall place hay bales, or approved protection, to limit intrusion upon project area. Additional environmental protection necessary to contain any hydraulic or drilling fluid spills shall be put in place, including berms, liners, turbidity curtains, and other measures. Contractor shall adhere to all applicable environmental regulations including environmental condition stated in local, state, and federal permits. Fuel may not be stored in bulk containers (greater than 25 gallons) within 200' of any water-body or wetland.
- 1.3.2 Shop Drawings: Submit shop drawings and product data for pipe material, drilling mud, polymers and equipment furnished under this Section in accordance with the General Conditions.
- 1.3.3 Pipe Installation Certificate: Upon completion of the directional drills, the subcontractor shall provide a written report, through the Contractor and endorsed in writing by the Contractor, certifying that the pipe has been properly installed, checked, pressure tested and is ready for placement into routine permanent service. As part of the Contractor's submittal, a complete

as-built drawing shall be submitted which shows the pipe location in 3 dimensions, x, y and z axis, at intervals not to exceed 10'.

#### 1.4 JOB CONDITIONS:

- 1.4.1 Planned night time work is expressly prohibited and will not be allowed unless approved by the Department of Transportation, the Owner and the Engineer.
- 1.4.2 All crossing operations shall be accomplished during daylight hours and shall not begin after the hour pre-established as the latest starting time that will allow completion during daylight hours.
- 1.4.3 When hazards of night time work are carefully considered and determined to be insignificant, night time work may be allowed only to complete a properly planned crossing, and only if, in the opinion of the Engineer, the delay was caused by reasonably unavoidable circumstances, and that such night time work is necessary to avoid placing an undue economic hardship on the Contractor.
- 1.4.4 In emergency situations, or where delay would increase the likelihood of a failure, night time work may be allowed to complete a delayed crossing that is already in progress.

1.5 PRODUCT DELIVERY: The pipe and all equipment shall be factory prepared components delivered undamaged to the site. They shall be capable of being set in place and field connected with minimal field assembly. Material stored at the site shall be done in accordance with DOT criteria if it is stored within the DOT right-of-way.

## 2. MATERIALS

### 2.1 EQUIPMENT:

- 2.1.1 General: All equipment in the Directional Bore shall have the capacity, stability, and necessary safety features required to fully comply with the specifications and requirements of this section without showing evidence of undue stress or failure. It shall be the responsibility of the Contractor to assure that the equipment to be used in the Directional Bore is in sound operating condition. Backup equipment may be required in the event of an equipment breakdown and where the condition of the equipment to be used indicates that routine component replacement or repair will likely be necessary during the Directional Bore.

2.1.2 Directional Drilling System: The directional drilling equipment shall consist of truck-mounted field power unit and a frame-mounted drill unit. For small-sized rigs with capacities up to 40,000 pounds of push/pull and drill lengths of up to 500', the drill unit shall be dolly-mounted. For mid-size rigs with capacities of 40,000 to 100,000 pounds of push/pull and drill lengths of 500' to 2,000', the drill unit shall be trailer mounted as a package. A minimum crew of three people is required to operate the small-sized units and five people to operate the mid-size units. All tunneling system components shall be in sound operating condition with no broken welds, excessively worn parts, badly bent, or otherwise misaligned components. All ropes, cables, clamps, and other non-mechanical but essential items shall be in sound condition and replaced immediately when need is apparent.

1. Field Power Units: The field power unit shall be a self-contained system designed to provide a supply of high pressure bentonite cutting fluid to the drill unit. It shall contain, at minimum, a 1,000 gallon fluid storage tank for small-sized rigs and 3,000 gallons for mid-size rigs as well as a complete bentonite mixing system. The cutting fluid is to be mixed on site without the need for an external water supply. It shall permit changes to be made to the bentonite concentration during tunneling in response to changing soil conditions. The field power unit shall contain the power take-off driven high pressure bentonite pumping system.
2. Directional Drill System: A dolly-mounted version of the drill system shall include a thrust frame. Both the trailer-mounted and dolly-mounted drill system shall be designed to rotate and push 10-foot (3-meter) minimum hollow drill sections into the tunnel being created by the boring head. The drill sections may be made of a high strength steel which permits them to bend to a 30-foot (9-meter) radius without yielding. Drill end fittings shall permit rapid make-up of the drill sections while meeting the torque, pressure and lineal load requirements of the system. The boring head itself shall be capable of housing a probe used by the Magnetic Guidance System (MGS) to determine tool depth and location from surface and to orient the head for steering. For stream, river or other non-accessible crossings, a wireline steering tool system shall be utilized to eliminate the need for a walkover locating system.
3. Restrictions: Other devices or utility placement systems for providing horizontal thrust other than those previously defined in the preceding sections shall not be used unless approved by the Engineer prior to commencement of the work. Consideration for approval will be made on an individual basis for each specified location. The proposed device or system will be evaluated prior to approval or rejection on its potential ability to complete the utility placement

satisfactorily without undue stoppage and to maintain line and grade within the tolerances prescribed by the particular condition of the project. Water sluicing methods, jetting with compressed air, or boring or tunneling devices with vibrating type heads that do not provide positive control of the line and grade shall not be allowed.

- 2.1.3 Spoils Equipment: The bentonite removal system shall be a self-contained vacuum truck which has sufficient vacuum and capacity to remove excess bentonite mixture from the project site as required or directed by the Engineer.
- 2.1.4 Magnetic Guidance System: A Magnetic Guidance System (MGS) probe and interface shall be used to provide a continuous and accurate determination of the location of the drill head during the drilling operation. The tracker shall be capable of tracking at all depths up to one hundred feet and in any soil condition, including hard rock. It shall enable the driller to guide the drillhead by providing immediate information on the tool face, azimuth (horizontal direction), and inclination (vertical direction). The tracker shall be accurate to  $\pm 2\%$  of the vertical depth of the borehole at sensing position at depths up to one hundred feet. Ferrous materials shall not influence or affect the MGS readings or accuracy.

Components: The Contractor shall supply all components and materials to install, operate, and maintain the MGS. This shall include, but not be limited to, the following:

- MGS Probe and Interface
- Computer, Printer, and Software
- DC Power Source, Current Control Box, and Tracking Wire

The Magnetic Guidance System (MGS) shall be a Sharewell TruTracker MGS, or other approved wire guidance system, and shall be setup and operated by personnel experienced with this system. "Walk-over" tracking systems shall not be used for stream, river or other non-accessible crossings, except as directed by the Engineer.

- 2.1.5 If equipment breakdown or other unforeseen stoppages occur and forward motion of the directional cutting head is halted at any time other than for reasons planned in advance (addition of drill stems, etc.), the boring path shall be immediately filled with a proper bentonite solution.
- 2.1.6 The boring tool shall have steering capability and have an electronic tool detection system. The position of the tool during operation shall be capable of being determined accurately both horizontally and vertically within 2% of the vertical depths of the boreholes. The boring tool shall have a nominal steering radius of 9 meters.

2.2 PIPE:

2.2.1 All carrier pipe to be installed by the Directional Bore operation shall be High Density Polyethylene (HDPE) Pipe and shall be as specified in *AWWA Standard for Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 63 In., for Water Distribution*. The pipe shall meet the requirements of ASTM D3350, PE 3408, DR 11.0, 160 psi rated, ductile iron pipe size. The pipe shall be color coded for the utility called for on the drawings. For potable water, the pipe shall have continuous blue stripes; for sanitary sewers, the pipe shall have green stripes; and for reuse water, the pipe shall have purple stripes. The pipe shall be of the size called for on the drawings with the following properties:

PROPERTIES FOR HDPE DR 11.0/160 PSI PIPE				
Nominal Pipe Size	Nominal OD (in.)	Minimum Wall (in.)	Average ID (in.)	Weight LB/FT
1 1/4"	1.660	0.151	1.340	0.31
1 1/2"	1.900	0.173	1.533	0.41
2"	2.375	0.216	1.917	0.64
3"	3.500	0.318	2.826	1.39
4"	4.500	0.409	3.633	2.30
5 3/8"	5.375	0.489	4.338	3.27
5"	5.563	0.506	4.490	3.50
6"	6.625	0.602	5.349	4.97
7 1/8"	7.125	0.648	5.751	5.75
8"	8.625	0.784	6.963	8.42
10"	10.750	0.977	8.679	13.09
12"	12.750	1.159	10.293	18.42
13 3/8"	13.375	1.216	10.797	20.26
14"	14.000	1.273	11.301	22.20
16"	16.000	1.455	12.915	29.00
18"	18.000	1.636	14.532	36.69
20"	20.000	1.818	16.146	45.30



PROPERTIES FOR HDPE DR 11.0/160 PSI PIPE				
Nominal Pipe Size	Nominal OD (in.)	Minimum Wall (in.)	Average ID (in.)	Weight LB/FT
22"	22.000	2.000	17.760	54.82
24"	24.000	2.182	19.374	65.24

2.3 DRILLING FLUIDS:

2.3.1 A mixture of premium Wyoming Bentonite clay and potable water is to be used as the cutting fluid for the Directional Bore. The Bentonite mixture used shall have the minimum viscosities as measured by a March Funnel:

Rock Clay	60 seconds
Hard Clay	40 seconds
Soft Clay	45 seconds
Sandy Clay	90 seconds
Stable Sand	120 seconds
Loose Sand	150 seconds
Wet Sand	150 seconds

These viscosities may be varied to best fit the soil conditions encountered.

2.3.2 No other chemicals or polymer surfactant shall be used in the drilling fluid without written consent of the Engineer and after a determination is made that the chemicals to be added are not harmful or corrosive to the facility and are environmentally safe.

2.3.3 Drilling fluid pressures and flow rates shall be continually monitored and recorded by the Contractor. The pressure shall be monitored at the pump. These measurements shall be made during pilot bore drilling, reaming, and pullback operations.

2.4 TRACER WIRE: All non-metallic water main pipe directionally drilled shall have a #8 gauge, 49 strand 302 stainless steel, HMW-HDPE type insulation trace wire (blue in color) attached for locating purposes. Half hitch knot's or other means shall be used to fasten the wire to the pipe at 10 to 20' spacings. Trace wire shall be run into valve boxes. Watertight splicing connectors shall be utilized for all splices. Contractor shall be responsible for continuity of trace wire between valve boxes.

### 3. INSTALLATION

#### 3.1 PERSONNEL REQUIREMENTS:

- 3.1.1 A competent and experienced supervisor representing the Contractor and Drilling Subcontractor shall be present at all times during the actual crossing operations. A responsible representative that is thoroughly familiar with the equipment and type work to be performed must be in direct charge and control of the operation at all times. In all cases, the supervisor must be continuously present at the job site during the actual Directional Bore operation.
- 3.1.2 The Contractor and Subcontractor shall have a sufficient number of competent workers on the job at all times to insure the Directional Bore is made in a timely and satisfactory manner. Adequate personnel for carrying out all phases of the actual Directional Bore operation must be on the job site at the beginning of work.
- 3.1.3 All HDPE pipe welding shall be completed by a certified welder which is certified by the manufacturer of the pipe.
- 3.1.4 The Engineer and FDOT must be notified a minimum of 48 hours in advance of starting work. The Directional Bore shall not begin until the Engineer or his representative is present at the job site and agrees that proper preparations for the operation have been made. The Engineer's approval for beginning the installation shall in no way relieve the Contractor of the ultimate responsibility of the satisfactory completion of the work as authorized under the Contract.
- 3.1.5 If the Contractor fails to begin the Directional Bore at the agreed time, the Engineer will establish the next mutually convenient time to begin. To avoid undue hardship of either party, reasonable and mutual cooperation should be exercised where starting times are concerned.

#### 3.2 INSTALLATION:

- 3.2.1 The Contractor shall be responsible for providing a Maintenance of Traffic (MOT) Plan to the agency having authority over the road right-of-way for approval. The MOT Plan shall show the location of all barricades, signs and alternate routes for local traffic and pedestrian safety. Erection of the appropriate safety and warning devices in accordance with the Florida Department of Transportation (FDOT) Manual on Traffic Control and Safe Practices shall be completed prior to beginning work.
- 3.2.2 All excavation for entry and recovery pits and any other excavation necessitated by the Directional Bore shall be as specified in FDOT's Standard

Specifications for Road and Bridge Construction. The cost of restoring pavement, curb, sidewalk, driveways, lawns, storm drains, etc., and other landscaped facilities shall be borne by the Contractor as part of the lump sum unit price for the directional drill.

3.2.3 The following is a sequence of steps which must be adhered to for the Directional Bore operation:

1. Drill Path: Prior to drilling, Contractor shall utilize all verified locate information to determine drill pathway. Marked up drawings (see Site Preparation paragraph) shall be on site at all times and referred to during the drill operation.
2. Guidance System: Contractor shall provide and maintain instrumentation necessary to accurately locate the pilot hole (both horizontal and vertical displacements), measure pilot string torsional and axial and measure drilling fluid discharge rate and pressure. The Engineer shall have access to instrumentation and readings at all times during operation.
3. Pilot Hole: The pilot hole shall be drilled along the path shown on the drill path drawings or as modified by the Contractor and approved by the Engineer in the field. Unless approved otherwise by the Engineer, the pilot hole tolerances shall be as follows:
  - a. Elevation: As shown on the plans.
  - b. Alignment:  $\pm 1$  foot.
  - c. Curve Radius: The pilot hole radius shall be no less than 80% of the maximum bending radius as recommended by the pipe manufacturer of the pipe being installed. In no case shall the bending radius be less than 30 pipe diameters, unless approved otherwise by the Engineer.
  - d. Entry Point Location: The exact pilot hole entry point shall be within  $\pm 1$  foot of the location shown on the drawing or as directed by the Engineer.
  - e. Exit Point Location: The exit point location shall be within  $\pm 1$  foot of the location shown on the drawing or as directed by the Engineer in the field.
  - f. Limitations on Depth: The planned depths shall be maintained as shown on the plans unless the Engineer demonstrates that Contractor's shallower or deeper installation is acceptable.

4. Pull Back: After successfully reaming bore hole to the required diameter, Contractor will pull the pipe through the bore hole. In front of the pipe will be a swivel and reamer to compact bore hole walls. Once pull-back operations have commenced, operations must continue without interruption until pipe is completely pulled into bore hole. During pull-back operations, Contractor will not apply more than the maximum safe pipe pull pressure at any time. Maximum allowable tensile force imposed on the pull section shall be equal to 80% of the pipe manufacturer's safety pull (or tensile) strength.
  - a. Torsional stress shall be minimized by using a swivel to connect a pull section to the reaming assembly.
  - b. The pullback section of the pipeline shall be supported during pullback operations so that it moves freely and the pipe is not damaged.
  - c. External pressure shall be minimized during installation of the pullback section in the reamed hole. Damaged pipe resulting from external pressure shall be replaced at no cost to the Owner.
  - d. Buoyancy modification shall be at the discretion of the Contractor and shall be approved by the Engineer. The Contractor shall be responsible for any damage to the pull section resulting from such modifications.
  - e. In the event that pipe becomes stuck, Contractor will cease pulling operations to allow any potential hydro-lock to subside and will commence pulling operations. If pipe remains stuck, Contractor will notify the Engineer. Owner, Engineer, and Contractor will discuss options and then work will proceed accordingly.
  - f. For HDPE DR-17 pipe with a pulling length greater than 500 LF, the Contractor shall utilize a break-away link. Contractor shall provide a break-away link between the swivel and the pipe or a combination swivel and break link. Break-away link shall be rated at 80% of pipe manufacturer's safe pull (tensile) strength. Break pins shall be color coded for easy identification. Contractor shall provide rated break-away link for each material and pipe size(s) for the project.

5. Pipe Assembly:

- a. Pipe shall be welded/fused together in one length, if space permits. Pipe may be placed on pipe rollers before pulling into bore hole to minimize damage to the pipe. It is critical that all original oxidized pipe surface be removed in order for fusion to take place. The scraping process requires that approximately 0.10" of the outer "skin" be removed in order to penetrate the oxidation and contamination barrier. Oxidized pipe surface simply will not bond.
- b. Acceptability of Damaged Pipe: Cuts or gouges that reduce the wall thickness by more than 10% is not acceptable and must be cut out and discarded.
- c. Butt Fusion Testing: When requested by the Engineer, butt fusion testing will be performed. The test fusion shall be allowed to cool completely, and then fusion test straps shall be cut out. The test strap shall be 12" (min) or 30 times the wall thickness in length with the fusion in the center and 1" (min) or 1.5 times the wall thickness in width. Bend the test strap until the ends of the strap touch. If the fusion fails at the joint, a new test fusion shall be made, cooled completely, and tested.
- d. General Requirements for Open-Cut Construction: Mains shall be constructed of the materials specified and as shown on the drawings. Pipe and fittings shall be carefully handled to avoid damage, and if feasible, while they are suspended over the trench before lowering, they shall be inspected for defects and to detect cracks. Defective, damaged, or unsound pipe or fittings shall be rejected. Each section of the pipe shall rest upon the pipe bed for the full length of its barrel. Any pipe which has its grade or joint disturbed after laying shall be taken up and re-laid. Only suitable soils (no heavy clay) shall be utilized in the backfill operation up to 12 inches above the pipe. All precautions shall be taken to prevent sand or other foreign material from entering the pipe during installation. If necessary, a heavy, tightly woven canvas bag of suitable size shall be placed over each end of the pipe before lowering into the trench and left there until the connection is made to the adjacent pipe. Any time the pipe installation is not in progress, the open ends of the pipe shall be closed by a watertight plug or other method approved by the Engineer. Plugs shall remain in pipe ends until all water is removed from the trench. Any sand or foreign material that

enters the pipe shall be removed from the pipe immediately. No pipe shall be installed when trench conditions (standing water, excess mud, etc.) or the weather (rain, etc.) is unsuitable for such work, except by permission of the Engineer. Any section of pipe already laid which is found to be defective or damaged shall be replaced with new pipe. The Contractor shall coordinate utility locates with Sunshine State One-Call of Florida, Inc. (# 800-CAREFUL), at a minimum. The cover over all piping less than 24 inch size shall be a minimum of 30 inches in unpaved areas and 36 inches in paved areas with a maximum of 60 inches, unless approved otherwise by the Engineer. Cover for pipe under pavement shall be measured from the finished grade. Any reduction in pipe cover will require approval from the Engineer. Greater depths will be permitted where required to miss obstructions only. Lines shall be located as shown on the drawings. The Contractor shall investigate well in advance of pipe laying any conflicts which may require readjustments in planned locations and advise the Engineer of the results of these investigations so that the Engineer may give instructions as to the modifications required.

### 3.3 TESTING AND DISINFECTION:

- 3.3.1 Flushing of Completed Pipelines: Each section of completed pipeline shall be as thoroughly flushed as is possible. A minimum flow shall be used for flushing that will insure a velocity in the pipe of 2.5 ft. per second. Water required for testing and flushing shall be furnished by the Owner at existing pipes and outlets. Contractor shall be responsible for providing suitable temporary backflow preventer devices for use during flushing operations.
- 3.3.2 Leakage Test: Leakage and pressure tests shall be conducted in the presence of the Engineer. The Contractor shall provide all necessary apparatus including a pump, flow measuring device, piping connections and fittings and the necessary labor to conduct the tests. The pressure test shall be performed in two phases. In the first phase, an initial test pressure of 150 psi or the rated pipe pressure, whichever is less, shall be applied and allowed to stand for a minimum of 2.0 hours and a maximum of 3.0 hours without make-up pressure. The initial pressure test phase allows the pipe to stabilize in regards to diametric expansion and longitudinal stretching. In the second phase of the pressure test, the test pressure shall be returned to 150 psi or the rated pipe pressure, whichever is less, and held for 2.0 hours. The allowable amounts of make-up water are given in the following:

ALLOWANCE FOR EXPANSION UNDER TEST PRESSURE* (Reference ASME B31.8, Appendix N)		
Nominal Pipe Size (in.)	Allowance for Expansion (U.S. Gals./100 Feet of Pipe)	
	2-Hour test	3- Hour test
3	0.15	0.25
4	0.25	0.40
6	0.60	0.90
8	1.0	1.5
10	1.3	2.1
11	2.0	3.0
12	2.3	3.4
14	2.8	4.2
16	3.3	5.0
18	4.3	6.5
20	5.5	8.0
22	7.0	10.5
24	8.9	13.3
28	11.1	16.8
32	14.3	21.5
36	18.0	27.0
40	22.0	33.0
48	27.0	43.0
54	35.0	55.0

\* These allowances only apply to the test period and not to the initial expansion phase.

[For fusible PVC pipe, no pipe installation will be accepted if the leakage exceeds the quantities specified in AWWA C605, which is represented by the following equation.

$$Q = \frac{LD\sqrt{P}}{148,000}$$

Where:

Q = Quantity of makeup water (allowed) in gallons per hour

L = Length of pipe section being tested, in feet

D = Nominal diameter of the pipe, in inches

P = Average test pressure during the hydrostatic test, in pounds per square inch (gauge)]

3.3.3 Disinfection of Complete Potable Water Main Pipeline: Following completion, the Contractor shall disinfect all potable water distribution mains and service lines in accordance with AWWA C651. Water shall be fed slowly into the system applying sufficient chlorine to produce a dosage in excess of 50 ppm at the farthest point in the system from the point of application. The chlorine solution then shall be retained in the line for a period of 24 hours. At the end of this time if a minimum chlorine residual of 5 ppm is not obtained, the procedure shall be repeated. During the disinfection process all valves shall be operated. After disinfection, the water shall be flushed from the system at its extremities until excessive chlorine residuals are eliminated. Water samples for bacteriological examination shall be taken as directed by HRS Department of Health and submitted to the nearest approved bacteriological laboratory. Disinfection shall not be considered satisfactory until laboratory reports are satisfactory to the State Department of Health.

#### 3.4 SCHEDULE:

##### 3.4.1 Connection to Existing System:

1. All connections to existing mains shall be made after complete disinfection of the proposed system and shall be made under the direction of the owners of the existing system. Valves separating the mains being installed from existing mains shall be operated by or under the direction of said owner's representative. The cost of the work in making the connections shall be paid for by the Contractor.
2. In the event the proposed main is to be connected to a main which has one or more active services between the point of connection and the first connection and the first existing line valve, a temporary plug or cap shall be installed on the new main until the pressure tests and disinfecting are completed. Upon satisfactory completion, the cap or



plug shall be removed from both mains and the connection made with pipe which has been scrubbed out with a solution of chlorine and water. The connection shall be made as swiftly as possible and any water in the ditch shall be kept below the level of the pipe. The pipeline shall then be placed in service by the Owner's personnel.

3. In the event any existing users will be without water while a connection is being made, the Contractor shall notify the users when the water will be turned off and when the service will be resumed. In some instances, these connections may have to be made at night. No user shall be without water service without prior approval from the Owner.

### 3.5 RECORDS:

3.5.1 An accurate log shall be kept by the Contractor on all installations. The purpose of this log is to record and report the data necessary to isolate and identify all common factors associated with underground crossing failures.

3.5.2 The MGS data shall be recorded every 10 feet during the actual crossing operation. The Contractor shall furnish "As-Built" plan and profile drawings based on these recordings showing the actual location horizontally and vertically of the installation and all utility facilities found during the installation. The MGS data shall be certified accurate by the Contractor to the capability of the MGS System.

3.6 RESTORATION OF DAMAGED SURFACES, STRUCTURES AND PROPERTY: Where pavement, trees, shrubbery, fences or other property and surface structures not designated as pay items, have been damaged, removed or disturbed by the Contractor, whether deliberately or through failure to carry out the requirements of the contract documents, state laws, municipal ordinances or the specific direction of the Engineer, or through failure to employ usual and reasonable safeguards, such property and surface structures shall be replaced and repaired at the expense of the Contractor to a condition equal to that before work began within a time frame approved by the Engineer.

3.7 CLEANUP: The Contractor shall maintain the site of the work in a neat condition. The Contractor shall remove all excess materials, excess excavated materials and all debris resulting from his operations within a time frame approved by the Engineer.

END OF SECTION



SECTION 33 11 00

PIPE WORK - PRIVATE DISTRIBUTION SYSTEM

1. GENERAL:

1.1 DESCRIPTION: Work under this Section consists of furnishing all materials, supplies, equipment and labor in accordance with the requirements set forth herein and as shown on the Drawings.

1.2 APPLICABLE CODES, STANDARDS AND SPECIFICATIONS: The work under this Contract shall be in strict accordance with the following codes and standards.

1.2.1 All Local, County, Municipal and Federal Codes.

1.2.2 American National Standards Institute (ANSI).

1.2.3 American Society for Testing and Materials (ASTM).

1.2.4 American Water Works Association (AWWA).

1.2.5 American Association of State Highway and Transportation Officials (AASHTO).

1.2.6 Florida Department of Transportation Specifications (DOT).

1.2.7 Recommended Standards for Water Works, 10-States Standards. (RSWW).

1.2.8 Florida Dept. of Environmental Protection (FDEP).

1.2.9 National Fire Protection Association (NFPA).

1.3 QUALITY ASSURANCE STANDARDS:

1.3.1 American National Standards Institute, Inc. (ANSI)/American Water Works Association (AWWA):

1. ANSI/AWWA C104, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.

2. ANSI/AWWA C105, Polyethylene Encasement for Ductile - Iron Piping for Water and Other Liquids.

3. ANSI/AWWA C111, Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.
4. ANSI/AWWA C115, Flanged Ductile-Iron Pipe with Threaded Flanges.
5. ANSI/AWWA C150, Thickness Design of Ductile-Iron Pipe.
6. ANSI/AWWA C151, Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds for Water or Other Liquids.
7. ANSI/AWWA C153, Ductile-Iron Compact Fittings, 3 In. Through 16 In., for Water and Other Liquids.
8. AWWA C502, Dry-Barrel Fire Hydrants.
9. AWWA C504, Rubber-Seated Butterfly Valves.
10. AWWA C515, Reduced Wall, Resilient-Seated Gate Valves for Water Supply Service.
11. AWWA C600, Installation of Ductile-Iron Water Mains and Their Appurtenances.
12. AWWA C605, Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
13. AWWA C651, Disinfecting Water Mains.
14. AWWA C701, Cold-Water Meters - Turbine Type, for Customer Service.
15. AWWA C800, Underground Service Line Valves and Fittings.
16. AWWA C900, Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In., for Water Distribution.
17. AWWA C905, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. through 48 In. for Water Transmission and Distribution.

1.3.2 American Society for Testing and Materials (ASTM):

1. D1785, Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.

2. D2464, Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fillings, Schedule 80.
3. D2467, Socket Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
4. D2564, Solvent Chemicals for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
5. D2855, Making Solvent Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.

1.3.3 Manufacturer's name and model numbers are listed to establish a standard of quality. Equivalent items of other manufacturers are acceptable.

#### 1.4 SUBMITTALS:

- 1.4.1 Submit manufacturer's certification of materials' conformance to specifications.
- 1.4.2 Submit manufacturer's literature, catalog data and installation instructions.
- 1.4.3 Submit certified field pressure test reports.
- 1.4.4 Backflow Certification and testing results.
- 1.4.5 Field flow tests for fire system components in accordance with NFPA 24.

#### 1.5 PRODUCT DELIVERY AND HANDLING:

- 1.5.1 Exercise care to prevent damage of product during loading, transporting, unloading and storage.
- 1.5.2 Do NOT drop pipe or fittings.
- 1.5.3 Do not store directly on ground and assure that materials are kept clean. Pipe shall be kept bundled and strapped until it is ready for installation in order to prevent warping or disfiguring.
- 1.5.4 Store material in areas approved by the Owner.
- 1.5.5 Store material in such a manner as to not create a nuisance or safety hazard.

## 2. MATERIALS

### 2.1 PIPE:

2.1.1 General: Pipe shall be furnished free from defects impairing strength and durability and should be of best commercial quality for purpose specified. Structural properties shall be sufficient to safely sustain or withstand strains to which it is normally subjected. All pipe shall bear the National Sanitation Foundation Seal for potable water pipe.

### 2.1.2 Pipe Materials:

#### 1. Ductile Iron (D.I.) ANSI/AWWA C151:

##### a. Metal Thickness, ANSI/AWWA C150:

- 1) 3 Inch through 12 Inch: Pressure Class 350.
- 2) 14 Inch and Larger: Pressure Class 250.
- 3) Jack and Bore Crossings: Pressure Class 350.

##### b. Interior Lining, ANSI/AWWA C104: mortar lined.

##### c. Exterior Coating, Bituminous Coating, 1 Mil thick.

#### 2. Polyvinyl Chloride (PVC) 14 In. and larger:

##### a. Specification: AWWA C905.

##### b. Compound: PVC 12454-B, ASTM D1784.

##### c. Thickness: Class 165, DR 25.

#### 3. WATER SERVICE: Polyvinyl Chloride (PVC) 4 In. Through 12 In.:

##### a. Specification: AWWA C900.

##### b. Compound: PVC 12454-B, ASTM D1784.

##### c. Thickness: Class 150, DR 18.

#### 4. FIRE SERVICE: Polyvinyl Chloride (PVC) 4 In. Through 12 In.:

##### a. Specification: AWWA C900.

##### b. Compound: PVC 12454-B, ASTM D1784.

- c. Thickness: Class 200, DR 14.
- 5. Polyvinyl Chloride (PVC), 3 In.:
  - a. Specification: ASTM D2241.
  - b. Compound: PVC 12454-B, ASTM D1784.
  - c. Thickness: Class 200, DR 18.
- 6. Polyvinyl Chloride (PVC), 2 In. and Smaller:
  - a. Specification: ASTM D1785.
  - b. Compound: PVC 12454-B, ASTM D1784.
  - c. Thickness: Schedule 80.
- 7. Galvanized Steel (GS), 3 In. and Smaller:
  - a. Specification: ASTM A53.
  - b. Thickness: Schedule 40.

### 2.1.3 Pipe Joints:

- 1. Ductile Iron:
  - a. Mechanical: ANSI/AWWA C111.
  - b. Push On: ANSI/AWWA C111, single gasket type.
  - c. Flanged: ANSI B16.1, 125 lb.
  - d. Restrained: Acceptable: Lock-Fast, American Ductile Iron Pipe; TR Flex, U.S. Pipe; Super-Lock, Clow Corporation; Megalug 1100 and 1700 Series.
- 2. Polyvinyl Chloride, 3 In. and Larger:
  - a. Push On: ASTM F477 Elastomeric Gaskets
  - b. Restrained: UNI-BELL B-13, Uni-Flange Restrainer; Megalug 2000 PV and 1600 Series.

3. Polyvinyl Chloride, 2 In. and Smaller:

- a. Screwed: ASTM D2464.
- b. Solvent Weld: ASTM D2855.
- c. Solvent: ASTM D2564.

2.1.4 Pipe Fittings:

1. Ductile Iron and Polyvinyl Chloride (PVC) 3 In. and Larger:

- a. ANSI/AWWA C153, ductile iron compact fittings.
- b. ANSI/AWWA C104, mortar lined.
- c. Mechanical: ANSI/AWWA C111.
- d. Push On: AWSI/AWWA C111.
- e. Flanged: ANSI B16.1, 125 lb.
- f. Restrained-Ductile Iron: Same as Ductile Iron Pipe Joints.
- g. Restrained-PVC: Same as PVC Pipe Joints.

2. Polyvinyl Chloride (PVC) 2 In. and Smaller:

- a. ASTM D2464, Schedule 80 PVC threaded fittings.
- b. ASTM D2467, Schedule 80 PVC socket type fittings.
- c. ASTM D2855, solvent weld joints.

2.1.5 Pipe Marking and Identification:

- 1. Ductile Iron Pipe: Permanent marking tape, with the words “WATER MAIN” printed along the tape, shall be attached to the pipe for its entire length. In addition, similar marking tape shall be placed in the trench over the pipe, six to twelve inches below finished grade, of the entire length of pipe.



## 2. PVC Pipe:

- a. All non-metallic water main pipe installed underground shall have a #12 gauge, solid strand, copper type UF insulation trace wire (blue in color) attached for locating purposes. Half hitches shall be made behind each pipe bell and on each side of a valve or fitting. Branch splices shall be made at all tees, fire hydrants, and service lines. Trace wire shall be run into valve boxes. Watertight splicing connectors shall be utilized for all splices. Contractor shall be responsible for continuity of trace wire between valve boxes.
- b. All PVC water main pipe shall be manufacturer's standard blue color or shall have permanent marking tape attached with the words "WATER MAIN" printed along the tape. In addition, similar marking tape shall be placed in the trench over the pipe, six to twelve inches below finish grade, for the entire length of pipe.

## 2.2 GATE VALVES:

2.2.1 Larger than Two Inch: Shall be AWWA C515, iron body, resilient wedge, resilient seat, non-rising bronze stem with 2" square operating nut on buried valves, turn to left (counter clockwise) to open.

1. Working pressure of 200 psi.
2. Internal Metal Surfaces shall have two-part thermosetting epoxy coating, 4 mils thick.
3. Sealing Mechanism shall have zero leakage at 200 psi with flow in either direction.
4. End Conditions: Fit joints specified and/or required for piping.
5. Acceptable: Mueller Series A-2370, American Series 2500 or equal.
6. Provide (2) two valve wrenches for each type of valve installed.

2.2.2 Two Inch and Smaller:

1. Type III (double wedge disc, rising stem, inside screw).
2. Class B.

- 3. Threaded ends.
  - 4. 150 psi working pressure.
- 2.3 HOSE BIBBS (3/4"):
  - 2.3.1 Body to be all brass construction.
  - 2.3.2 Male connection threads suitable for 3/4" hose connection.
  - 2.3.3 Loose key, anti-tamper operation.
  - 2.3.4 Anti-siphon check valve connection to hose.
- 2.4 YARD HYDRANT (3/4"):
  - 2.4.1 Encased, non-freeze ground hydrant for flush with grade or finished floor installation, complete with galvanized steel casing, all bronze interior parts, replaceable bronze seat and seat washer, non-turning operating rod with free-floating compression closure valve, and 3/4" female IP inlet connection.
  - 2.4.2 Lockable chrome-plated bronze box and hinged cover. Provide (2) keys with each unit installed.
  - 2.4.3 Hydrant shall be equipped with a tapped 1/4" drain port in the valve housing, and 3/4" hose connection
  - 2.4.4 Equipped with integral vacuum breaker.
  - 2.4.5 Zurn Z1361-CL-VB or equal.
- 2.5 VALVE BOXES:
  - 2.5.1 Provide at all manually operated valves installed on underground lines.
  - 2.5.2 ASTM A48, cast iron, Class 30-B, 3-piece extension type, with cover marked "WATER" and flared base to suit valve furnished.
  - 2.5.3 Acceptable: Figure No. F-2450, Clow Corporation; Catalog No. H10357, Mueller Co.; Figure No. E-3002, M & H Valve and Fittings Co. or equal.
- 2.6 FIRE HYDRANTS:
  - 2.6.1 AWWA C502 Dry-Barrel type fire hydrant with 5 1/4" main valve.

- 2.6.2 Working Pressure Rating 150 psi.
- 2.6.3 Provided with two 2 ½ Inch hose connections and one 4 ½ In. hose connection.
- 2.6.4 Outlet Threads shall have external threads in accordance with NFPA 1963.
- 2.6.5 Provide (2) two hydrant wrenches.
- 2.6.6 Acceptable: American Darling B-62-B; Clow Medallion Hydrant, Mueller BSR 5 1/4" or equal.
- 2.7 FLUSHING VALVE:
  - 2.7.1 Blow offs shall be box hydrants with a 2" main valve and a 2" bronze, male, thread discharge nozzle.
  - 2.7.2 All hydrants shall have lockable iron lids, all bronze working parts and removable bronze seats with rubber seals.
  - 2.7.3 One 24"-long operating wrench shall be provided for every three hydrants furnished.
  - 2.7.4 Working Pressure: 150 psi.
  - 2.7.5 Acceptable: Kupferle Foundry, Model 85B; H20K, Inc., the Sample Station; or equal.
- 2.8 TAPPING SADDLES:
  - 2.8.1 For Ductile Iron Mains: Service Saddles shall be made of malleable or ductile iron with a 4-bolt, stainless steel, ductile iron, cast brass or bronze strap.
  - 2.8.2 For Polyvinyl Chloride (PVC) Mains: Service Saddles shall be made of cast brass or bronze with a 4-bolt stainless steel, cast brass or bronze strap.
  - 2.8.3 The backside face of the saddle shall be provided with an extra-wide neoprene-rubber gasket.
  - 2.8.4 The inside diameter of the saddle shall match that of the pipe outside diameter for a size-size match.

2.9 REDUCED PRESSURE ZONE BACKFLOW PREVENTER:

2.9.1 3/4" to 2":

1. Bronze body construction.
2. Two (2) poppet-type check valve assemblies and relief valve.
3. Unit shall have replaceable seats and springs and be capable of in-line maintenance.
4. Four (4) test cocks for field testing.
5. Minimum working pressure: 150 psi.

2.9.2 2" to 10":

1. Bronze or epoxy coated cast iron body.
2. Two (2) poppet-type check valve assemblies and relief valve.
3. Two (2) gate valves.
4. Four (4) test cocks for field testing.
5. Unit shall be of modular design and capable of inline servicing.
6. Replaceable seats.
7. Minimum working pressure: 150 psi.

2.9.3 All units shall be certified in accordance with local utility requirements.

2.10 DOUBLE DETECTOR CHECK ASSEMBLY:

- 2.10.1 Fused epoxy coated cast iron body.
- 2.10.2 Replaceable bronze seats.
- 2.10.3 5/8" x 3/4" bronze meter and ball type test cock.
- 2.10.4 Maximum working pressure 175 psi.
- 2.10.5 Conform to AWWA C510, ASSE 1048.
- 2.10.6 Resilient seat OSY shutoff valves with chain and lock.

2.11 CURB STOPS:

2.11.1 Curb stops shall be Mueller, Hayes, or Ford unless otherwise required by the local utility.

2.11.2 All curb stops shall have a locking wing.

2.12 METER COUPLINGS:

2.12.1 Meter Couplings shall be Mueller, Hayes, or Ford unless otherwise required by the local utility.

2.12.2 Couplings shall be straight meter couplings with M.I.P.T.

2.13 JOINT HARNESS: Steel straps and rods across joints, securely anchored on pipe or other adequate anchorage, to resist hydraulic thrust at maximum pressure pipe will be subjected to, 200 psi minimum.

2.13.1 Coal Tar Coating: Koppers Bitumastic No. 50.

2.13.2 Clamps, Straps, and Washers: Steel, ASTM A506.

2.13.3 Rods: Steel, ASTM A575.

2.13.4 Rod Couplings: Malleable Iron ASTM A197.

2.13.5 Bolts: Steel ASTM A307.

2.13.6 Cast Iron Washers: Gray-iron ASTM A126.

2.14 WATER METERS:

2.14.1 Unless otherwise provided or specified by the local utility, all Water Meters shall be AWWA C701, turbine-type, cold water meters. Meters shall have bronze bottoms, bronze lids, and annealed glass register cover, be made in the USA and come with a 15-year warranty.

2.14.2 Comply with requirements of local utility.

2.15 METER BOXES:

2.15.1 Water Meter Boxes shall be of cast iron construction with an in ground base and a removable cast iron cover. The overall size of the box shall accommodate the size of the water meter and the curb stop with additional space at each end of the box.

- 2.15.2 Acceptable: Rome Valve Box or equal.
- 2.16 CHECK VALVES: (3" to 10")
  - 2.16.1 Check valve open with 1 psi pressure differential in direction of flow.
  - 2.16.2 Four (4) test cocks for field testing.
  - 2.16.3 Epoxy coated cast iron body.
  - 2.16.4 Minimum rated working pressure 175 psi.
- 2.17 PLASTIC LOCATING AND MARKING TAPE: Tape shall be plastic coated foil with a minimum width of 2 inches. Tape shall be highly visible and shall have the words "WATER MAIN" in at least 1" letters printed at least every 36 inches along the tape. Tape shall be located one foot below ground surface directly above the centerline of the pipe. Tape shall be Allen Marking Tape or equal.
- 2.18 LOCATING WIRE: #14 GAUGE THHN Trace Wire with blue insulation.
- 2.19 THRUST BLOCKING: Not allowed.
- 2.20 POST INDICATOR VALVES: Buried quarter-turn valve with an above grade indicator-operator. Factory assembled unit with true orientation guarantee by the manufacturers. Equal to Henry Pratt Co., Type FM 1.
- 2.21 THERMAL PROTECTION:
  - 2.21.1 THERMAL WRAP: Minimum 3/4" thick elastomeric thermal insulation (ASTM D 1622 or D1667). The closed cell foam shall have a UV resistant PVC or aluminum exterior covering. Product shall provide a 10 year warranty on the membrane.
  - 2.21.2 HOT BOX: Insulated fiberglass box sized to fit RPZ and double detector check backflow prevention assemblies.
- 2.22 BACKFILL MATERIAL: All backfill shall be excavated material, essentially free of organic material, asphaltic concrete, clay, concrete, boulders and other deleterious material.
  - 2.22.1 Bedding and Haunching to 12" Above Top of Pipe: The Contractor shall furnish, place, and compact AASHTO Class A-3 sandy material containing less than 1% of organics or other unsuitable material.
  - 2.22.2 Above Pipe Embedment: The material shall be AASHTO Class A-3 material or AASHTO Class A-2-4 with prior approval from the Engineer.

- 2.22.3 Top of Backfill: The top 12 inches of the backfill shall be topsoil and/or AASHTO Class A-3 material with mixed organics.
- 2.22.4 Additional Fill: If sufficient suitable backfill material is not available from the excavation, additional fill meeting the above requirements shall be provided by the Contractor at no expense to the Owner.
- 2.22.5 All backfill shall be tested for compliance with above requirements prior to placement in accordance with Section 310000.
- 2.23 FDC SIAMESE CONNECTION: Cast brass with 4" riser connection and (2) 2½" female hose swivel inlets. Inlets shall be fitted with brass plug and chain.
- 2.24 CONCRETE: 3,000 psi 28 day strength mix, typical for all pipe encasements and concrete collars around utility access ports.

### 3. INSTALLATION:

#### 3.1 EXCAVATION:

##### 3.1.1 General:

1. The Contractor shall perform all excavation of every description and of whatever substances encountered to the depths indicated on the Drawings or as necessary.
2. Include all necessary clearing and grubbing of any foreign substance encountered within the structure or trench area.
3. Excavated material suitable for backfill shall be piled in an orderly manner at a sufficient distance from the trench to prevent slides or cave-ins.

##### 3.1.2 Protection of Existing Facilities and Utilities:

1. All existing improvements such as pavements, conduit, poles, pipes and other structures, shall be carefully supported and fully protected from injury and, in case of damage, they shall be restored, pressure tested and disinfected by the Contractor without compensation.
2. Existing utilities and other underground obstructions are shown on the plans, but the accuracy of the locations and depths is not guaranteed.

3. The Contractor shall contact all utilities prior to construction and arrange for the necessary assistance in locating and protecting the existing utilities.
4. The Contractor shall be responsible for damages to these existing utilities and shall, in the event they are damaged, restore them to their original condition.

3.1.3 Trench Excavation:

1. The minimum width of the trench shall be equal to the outside diameter of the pipe at the joint plus 8 in. each side of pipe for unsheeted or sheeted trench, with the maximum width of trench, measured at the top of the pipe, not to exceed the outside pipe diameter, plus 24 in., unless otherwise shown on the Drawings.
2. Trench walls shall be maintained vertical from the bottom of the trench to a line measured at the top of the pipe. From the top of the pipe to the surface of the trench walls shall be as vertical as possible under soil conditions.
3. No more than 300 linear feet of trench shall be open in advance of the completed pipe laying operation without prior approval of the Engineer.
4. Pipe trenches across roadways and driveways shall be backfilled as soon as the pipe is installed.
5. No trench shall be left open across any roadway or driveway for more than 24 hours.
6. It shall be the Contractor's responsibility to provide traffic control and barricades as necessary.

3.1.4 Shoring, Sheeting and Bracing:

1. The Contractor shall be responsible for the design, installation and maintenance of all shoring, sheeting and bracing required to perform and protect the excavation and ensure the safety of the public, employees, existing roads, structures and other utilities.
2. The top of any sheeting left in place shall be cut off at a minimum elevation of 2.5 ft. below finished grade.
3. The Contractor may substitute a properly designed trench box in lieu of permanent bracing, where applicable.



4. All excavation shall be in accordance with the Florida Trench Safety Act and all applicable requirements of OSHA.

3.1.5 Pavement Removal:

1. The Contractor shall remove pavements as part of the trench excavation.
2. The asphalt and base material from permanent pavement removal shall be carefully separated from trench excavation material.
3. Asphalt millings and base material shall be used in place of stabilized subgrade under the new pavement.

3.1.6 Boulder Removal: All rocks, stones, boulders or concrete, having any dimension larger than permitted to be used for backfill in the paragraph entitled "Backfilling" of these Specifications, shall be removed from the site and disposed of by the Contractor.

3.1.7 Unsuitable Soil Conditions and Overdepth Excavation: In the event the project encounters unsuitable materials, the Contractor shall construct an adequate foundation to support the pipe.

1. For Very Soft Clays (SC, CH, CL) ( $N < 2.5$  blows/ft) foundation shall consist of 4" of compacted AASHTO A-3 Sand.
2. For all other unsuitable soil conditions the foundation shall consist of 8" of compacted AASHTO A-3 Sand.
3. The foundation shall be overlain by 4" of bedding material. Bedding material shall be A-3 sand.
4. Shape bedding material to receive pipe bells and support 1/4 of the pipe surface.

3.1.8 Disposal of Excess Material:

1. All surplus excavated material which is unsuitable for fill shall become the property of the Contractor and shall be disposed of by the Contractor at his expense.
2. Surplus suitable backfill material shall become the property of the Owner. In the event the Owner declines to accept this material it shall become the property of the Contractor and be disposed of at no expense to the Owner.

### 3.2 INSTALLATION OF WATER MAINS AND SERVICES:

3.2.1 General: Unless otherwise noted on the Drawings or in other sections of this Specification, the pipe shall be handled and installed in strict accordance with the manufacturer's instructions and with the applicable AWWA or ASTM Standards.

1. Ductile Iron Pipe: AWWA C600.
2. Polyvinyl Chloride Pipe: ASCE Manual No. 37, ASTM D2321.
3. If a conflict exists between the manufacturer's instructions and the AWWA or ASTM Standards, the manufacturer's instructions shall govern.
4. Examine area to receive pipe work for defects that adversely affect execution of work or cause deviation beyond allowable tolerances for piping clearances.
5. Carefully examine each section of pipe or valve before installation. Do not use defective or damaged pipe or materials. Remove such pipe or material from project site immediately.

3.2.2 Preparation:

1. The Contractor shall use every precaution during construction to protect the pipe against the entry of nonpotable water, dirt, wood, small animals and other foreign material that would hinder the operation of the pipeline.
2. Where the groundwater elevation is above the bottom of the trench, the Contractor shall provide suitable dewatering equipment. All piping shall be placed in a dry trench.

3.2.3 Depth of Cover: Unless otherwise shown on the Drawings, or otherwise authorized by the Engineer, the pipe shall have a minimum cover of 30 inches in unpaved areas and 36 inches in paved areas.

3.2.4 Connections to Existing Mains:

1. The Contractor shall make connections to existing mains as shown on the Drawings.
2. Connections shall be made only after arrangements have been completed by the Contractor with the Owner of the system and shall be under the System Owner's immediate supervision.

Contractor shall be required to restrain existing pipe as necessary in accordance with pipe restraint schedule.

3.2.5 Pipe Thrust Restraints:

1. Mechanical restrainers shall be installed as required to properly restrain all piping systems.
2. Required lengths of restrained pipe each side of all fittings and valves shall be as shown in pipe restraint schedule at end of this paragraph for the type of soil encountered.
3. For above-grade piping, all valves and fittings shall be threaded, flanged or solvent welded with supports as required.



**PIPE RESTRAINT SCHEDULE**

MINIMUM LENGTH OF PIPE (IN FEET) REQUIRED TO BE  
RESTRAINED ON EACH SIDE OF A VALVE OR FITTING  
FOR SANDY SOILS (SW, SP, SM, SC)

PIPE TYPE	PIPE SIZE	90° BEND	45° BEND	≤22.5° BEND	TEE OR CROSS	VERTICAL		REDUCER <sup>b</sup>	VALVE	DEAD END
						LOW	HIGH			
P V C  P I P E	≤4	18	18	18	18	18	22	36	18	52
	6	24	18	18	18	18	30	38	36	73
	8	31	18	18	18	18	40	69	36	96
	10	37	18	18	18	18	48	93	54	115
	12	43	18	18	18	18	56	99	54	136
	14	49	20	18	18	18	64	101	72	155
	16	55	23	18	18	18	72	103	72	174
	18	60	25	18	36	20	80	104	72	192
	20	65	27	18	36	21	87	105	72	211
	24	75	31	18	36	25	102	134	90	246
	30	88	37	18	36	29	122	185	90	295

PIPE TYPE	PIPE SIZE	90° BEND	45° BEND	≤22.5° BEND	TEE OR CROSS	VERTICAL		REDUCER <sup>b</sup>	VALVE	DEAD END
						LOW	HIGH			
D U C T I L E  I R O N	≤4	18	18	18	18	18	18	18	18	33
	6	20	18	18	18	18	19	35	36	47
	8	26	18	18	18	18	25	44	36	61
	10	31	18	18	18	18	30	60	54	73
	12	37	18	18	18	18	36	63	54	86
	14	41	18	18	18	18	41	64	72	98
	16	46	19	18	36	18	46	66	72	111
	18	51	21	18	36	18	51	66	72	122
	20	56	23	18	36	18	56	67	72	134
	24	64	27	18	36	21	65	85	90	156
	30	75	31	18	36	25	78	118	90	188

**PIPE RESTRAINT SCHEDULE**

MINIMUM LENGTH OF PIPE (IN FEET) REQUIRED TO BE  
RESTRAINED ON EACH SIDE OF A VALVE OR FITTING  
FOR CLAYEY AND SILTY SOILS (CL, CH, ML, MH)

PIPE TYPE	PIPE SIZE	90° BEND	45° BEND	≤22.5° BEND	TEE OR CROSS	VERTICAL		REDUCER <sup>b</sup>	VALVE	DEAD END
						LOW	HIGH			
P V C  P I P E	≤4	19	18	18	18	18	23	36	18	55
	6	26	18	18	18	18	32	40	36	77
	8	35	18	18	18	18	42	73	36	101
	10	42	18	18	18	18	50	98	54	121
	12	50	21	18	18	18	59	104	54	143
	14	57	23	18	36	20	67	106	72	163
	16	64	27	18	36	23	76	109	72	183
	18	71	29	18	36	25	84	109	72	202
	20	78	32	18	36	28	92	110	72	221
	24	92	38	18	36	33	107	140	90	258
	30	110	46	22	54	40	127	193	90	308

PIPE TYPE	PIPE SIZE	90° BEND	45° BEND	≤22.5° BEND	TEE OR CROSS	VERTICAL OFFSET <sup>a</sup>		REDUCER <sup>b</sup>	VALVE	DEAD END
						LOW	HIGH			
D U C T I L E  I R O N	≤4	18	18	18	18	18	18	18	18	35
	6	22	18	18	18	18	20	25	36	49
	8	29	18	18	18	18	27	46	36	64
	10	35	18	18	18	18	32	62	54	77
	12	41	18	18	18	18	37	66	54	90
	14	47	20	18	18	18	43	67	72	103
	16	53	22	18	36	19	48	68	72	115
	18	59	24	18	36	21	53	69	72	127
	20	65	27	18	36	23	58	70	72	140

PIPE TYPE	PIPE SIZE	90° BEND	45° BEND	≤22.5° BEND	TEE OR CROSS	VERTICAL OFFSET <sup>a</sup>		REDUCER <sup>b</sup>	VALVE	DEAD END
						LOW	HIGH			
	24	76	31	18	36	27	67	89	90	162
	30	91	38	18	36	32	80	122	90	194

- Assumptions:
1. Pipe Test Pressure = 150 PSI
  2. Minimum Pipe Depth = 3.0 Feet
  3. Laying Condition = Type 5
  4. Safety Factor = 2.0

<sup>a</sup> "Low" represents the minimum length of pipe (in feet) required to be restrained on the low side of the vertical offset, which is typically downstream of the offset fitting. "High" represents the minimum length of pipe (in feet) required to be restrained on the high side of the vertical offset, which is typically upstream of the offset fitting. Required restrained lengths assume an offset angle  $\leq 45^\circ$ .

<sup>b</sup> Distance represents the linear feet of large diameter pipe upstream of the reducer required to be restrained. Restrain small diameter pipe at reducer at a minimum. If there is an unobstructed run downstream of the reducer (i.e. small diameter pipe) of at least 2.5 times the required length of large diameter pipe to be restrained, then restraint is required only at the reducer fitting. If small end of reducer is more than three pipe sizes smaller than large end, consult Engineer for required length to be restrained.

### 3.3 WATER AND SEWER LINE ORIENTATION:

#### 3.3.1 Water Mains Crossing Above Sewer Lines:

1. Potable water mains crossing above sanitary sewer lines (gravity and force mains) and storm sewers shall be laid to provide a minimum vertical distance of 6 inches between the invert of the water main and the crown of the sanitary sewer and/or storm sewer line. The crossing shall be arranged so that the water pipe joints are equal distance from the point of crossing with no less than 3 feet (outside of pipe to outside of pipe) between each joint & the sewer main.
2. The method of obtaining separation shall be as indicated on the Drawings or, or if not indicated on the Drawings, as directed by the Engineer.

3. The contractor shall notify the Engineer immediately upon encountering situations not indicated on the Drawings where inadequate separation between water and sewer lines may occur.

### 3.3.2 Water Mains Crossing Below Sewer Lines:

1. Maintain a minimum of 12 inches of separation.
2. All water main joints shall be a minimum of 3 feet clear from the sewer main and 6 feet from the nearest joint.
3. One full joint of water pipe shall be centered on the crossing.
4. Contractor shall notify the Engineer immediately upon encountering situations not indicated on Drawings where inadequate separation between water and sewer lines may occur.

### 3.3.3 Horizontal Separation Between Water Mains and Sewer Lines: A minimum horizontal separation of 10 feet shall be maintained between all water main joints and all sewer line joints, regardless of whether the lines cross or run parallel to each other. Water mains and sewer lines may be laid with a minimum of 3 feet horizontal separation (outside of pipe to outside of pipe; 5 feet for reuse water mains) provided that one or more of the following conditions is satisfied:

1. The crown of the sewer line is a minimum of 18 inches below the invert of the water main.
2. The sewer line is constructed of or replaced with 20 LF section(s) of ductile iron pipe with "polybond" lining.
3. Sewer line is placed in a sleeve.
4. Sewer line is encased in concrete.
5. The pipes are laid where the water main joints and the sewer main joints are staggered ten feet apart.
6. The water main or the sewer main is constructed of HDPE pipe without mechanical joints.

The method of obtaining separation shall be as indicated on the Drawings or, if not indicated in the Drawings, as directed by the Engineer. Contractor shall notify the Engineer immediately upon encountering situations not indicated on the Drawings where inadequate separation between water and sewer lines may occur.



3.3.4 Concrete Encasement of Pipe: Where concrete encasement of pipe is required for obtaining separation from other pipes or for other reasons (e.g., inadequate cover), the pipe shall be encased with 3,000 psi concrete having a minimum thickness of 6 inches all around the outside of the pipe. Pipe must be supported in trench to allow 6 inches of concrete on all sides. Concrete must be mechanically vibrated into place. The Engineer or his representative must be present at the time of encasement.

### 3.4 BACKFILLING:

#### 3.4.1 Placing and Compaction:

1. Bedding and Haunching: The backfill shall be placed by hand under and around the pipe to the springline and compacted. Particular care shall be taken to ensure that the backfill at the pipe haunch is free from voids and is properly compacted. The backfill shall be laid in lifts not to exceed 6" and compacted to a density of not less than 98% of maximum as determined by AASHTO T 180.
2. Pipe Embedment: Placement of backfill shall be completed in a 12" loose lift. Compaction of the lift shall achieve 98% of the maximum density modified proctor. Hand tamp or use light walk behind equipment in areas where subgrade soils are extremely soft ( $N \leq 4$ ).
3. Above Pipe Embedment in Areas of Permanent Pavement: The backfill shall be placed in layers having a depth that will permit proper compaction but not exceeding 12" of loose measure. The backfill shall be compacted to a density of not less than 98% of maximum as determined by AASHTO T 180.
4. Above Pipe Embedment In Areas Not Under Permanent Pavement: Within right-of-ways or other areas where permanent pavement does not exist or is not proposed, (including roads, walks and driveways consisting of broken stone, gravel, clay, marl, shell, shellrock or conglomerate), the entire backfill above the pipe embedment shall be compacted to a density of not less than 95 percent of the maximum density, as determined by AASHTO T 180.

3.4.2 In areas where unpaved, stabilized roads are required, the finished stabilized road shall have a minimum LBR value of 50 for the top 12" of the roadbed. Contractor shall refer to Drawings for roadway material.

3.4.3 Compaction:

1. Shall be by hand or by mechanical tampers.
2. Care shall be taken that the pipe is not struck by the tamper.
3. Compaction by flooding shall not be allowed.
4. The Contractor is to compact the backfill in such a manner to prevent settlement.
5. Compaction Tests:
  - a. Density tests shall be taken along the pipe a minimum of every 300 feet, at each road lane crossing, and as directed by Engineer.
  - b. All density tests shall be paid for by the Contractor.
  - c. Density tests shall be taken in one foot lifts from bottom of trench to finished grade.

3.5 CULVERT REMOVAL AND REPLACEMENT:

- 3.5.1 Culverts, catch basins and other drainage structures that are removed or damaged during construction shall be replaced with materials and structures equal and similar to those removed or damaged.
- 3.5.2 Manhole covers and gratings shall be set at the original elevations unless otherwise directed.
- 3.5.3 The Contractor shall take precautions against the entry of excavated and other loose material resulting from his operations from entering catch basins, culverts and other drainage structures in the vicinity of his operations.
- 3.5.4 The Contractor shall maintain the cleanliness of all existing drainage structures in a condition equal to that prior to the commencement of his operations during the construction.
- 3.5.5 The Contractor shall be responsible for all damage to persons, roads, buildings, vehicles and other property resulting from the failure of the Contractor to maintain these drainage structures.

### 3.6 TESTING AND DISINFECTION:

#### 3.6.1 Flushing of Completed Pipelines:

1. Each section of completed pipeline shall be thoroughly flushed. At a flow velocity in the pipe of 2.5 ft. per second.
2. Water required for testing and flushing will be furnished by the Contractor.
3. Contractor shall slowly fill system to eliminate air pockets, then flush to remove particulates.
4. Flushing shall comply with Figures 1 and 2, and Table 3 of AWWA C651.
5. Provide corporation stops at any high points in line in order to bleed air from pipe.
6. Contractor shall make provisions to properly dispose of water from his flushing operations.
7. Flooding of streets and private property shall not be permitted.

#### 3.6.2 Leakage Test:

1. Leakage and pressure tests shall be conducted in the presence of the Engineer or his representative.
2. The Contractor shall provide all necessary apparatus including a pump, flow measuring device, piping connections and fittings and the necessary labor to conduct the tests.
3. The pipe being tested shall be maintained at a pressure of not less than 150 psi for not less than two (2) hours in duration.
4. All leaks evident at the surface shall be repaired and leakage eliminated regardless of total leakage shown by test.
5. Lines which fail to pass tests shall be repaired and retested as necessary until test requirements are complied with. Defective materials, pipes, valves, and accessories shall be removed and replaced.
6. The pipe lines shall be tested in sections between every consecutive in-line valve unless otherwise directed by the Engineer.

7. Leakage is defined as the quantity of water added to the pipe being tested during the test period.
8. No pipe installation will be accepted if the leakage exceeds the quantities specified in AWWA C605, which is represented by the following equation.

$$Q = \frac{LD\sqrt{P}}{148,000}$$

Where:

Q = Quantity of makeup water (allowed) in gallons per hour

L = Length of pipe section being tested, in feet

D = Nominal diameter of the pipe, in inches

P = Average test pressure during the hydrostatic test, in pounds per square inch (gauge)

### 3.6.3 Disinfection:

1. The disinfection of water main piping shall be conducted in accordance with AWWA C651 using the continuous-feed method or table method and shall be performed by specially trained personnel.
2. New water piping shall be kept isolated from the existing distribution system using a physical separation until satisfactory bacteriological testing has been completed.
3. Provide all temporary filling, flushing and testing connections, potable water, chemicals, sampling and bacteriological test results.
4. Continuous-feed method:
  - a. Slowly and completely fill the main to remove air pockets.
  - b. Preliminary flush, and fill the main with chlorinated water having a free chlorine concentration of no less than 25 mg/l.
  - c. At the end of a 24-hour contact time, the heavily chlorinated water, having a free chlorine residual of not less than 10 mg/l, shall be flushed from the main until the chlorine concentration leaving the main is no higher than that prevailing in the existing distribution system.

- d. Neutralize the heavily chlorinated water leaving the main with one of the chemicals named in Appendix C of AWWA C651.
- e. Make final, permanent connections to existing mains in accordance with Section 4.6 of AWWA C651.
- f. Conduct bacteriological sampling and testing in accordance with Section 5 of AWWA C651.
- g. After sampling, maintain a minimum pressure of 20 psig in the mains until regulatory permission is granted to place the mains into service.
- h. Provide satisfactory test results consisting of two consecutive sets of samples, taken at least 24 hours apart, showing the absence of total coliform organisms and the presence of a chlorine residual.
- i. Redisinfect until satisfactory test results are obtained.

5. Tablet Method:

- a. Place calcium hypochlorite granules or tablets at the upstream end of the first joint, at 500' intervals and at the end of each branch main.
- b. Pipes must be kept clean and dry prior to testing.
- c. The quantity of granules or tablets shall conform to Table 1 or Table 2 of AWWA C651 respectively.
- d. After installation is complete the main shall be filled with water at a velocity no greater than 1 ft/sec.
- e. Remove air pockets with corporation stops at high points in the line.
- f. Water shall remain in the pipe for 24 hours.
- g. Test for free chlorine residual and absence of bacteriological organisms.
- h. Perform (2) Bac-T tests, 24-hours apart for every 1,200 LF of pipe installed.

- i. Redisinfect for unsatisfactory results.
- j. Maintain 20 psig pressure in main.

3.6.4 Flushing:

- 1. After receiving clearance from AHJ to place line into service, the line shall be flushed of all heavily chlorinated water.
- 2. Chlorinated water shall be neutralized prior to disposal with AWWA approved chemicals.

3.7 PROTECTION: At the end of each workday the mains under construction shall be plugged to prevent the entry of small animals or rodents. Temporary plugs shall be provided for this purpose.

3.8 CONCRETE COLLARS: All valve boxes and meter boxes shall have their lids at grade encased in a 24x24x8 concrete collar unless otherwise shown on the drawings.

3.9 THERMAL PROTECTION: All above-ground piping shall be freeze protected with custom fitting closed cell foam wrap and U.V. resistant covering.

3.10 RESTORATION OF DAMAGED SURFACES, STRUCTURES AND PROPERTY: Where pavement, trees, shrubbery, fences or other property and surface structures have been damaged, removed or disturbed by the Contractor, whether deliberately or through failure to carry out the requirements of the Contract Documents, state laws, municipal ordinances or the specific direction of the Engineer, or through failure to employ usual and reasonable safeguards, such property and surface structures shall be replaced and repaired at the expense of the Contractor to a condition equal to that before work began within a time frame approved by the Engineer.

3.11 RESTORATION AND CLEANUP:

3.11.1 Restoration:

- 1. General: Restoration of areas disturbed by the Contractor's operations shall begin as soon as practical. Contractor's restoration operations shall keep pace with utility installation. Engineer reserves the right to halt utility installation until restoration and cleanup requirements are satisfied.
- 2. Time Frame for Restoration: Restoration of areas disturbed by the Contractor's operations shall begin no later than 14 days and shall be completed (excluding punch list items) no later than 28 days from the time construction first began in the area. No more than 1,000 LF along the path of the work may be completely unrestored (excluding punch list items) at the end of each day.

3.11.2 Cleanup: The Contractor shall maintain the site of the work in a neat condition. The Contractor shall remove all excess materials, excess excavated materials, and all debris resulting from his operations a minimum of once per week.

END OF SECTION





SECTION 33 31 00

PIPE WORK - GRAVITY SEWER

1. GENERAL:

1.1 DESCRIPTION: Work under this Section consists of furnishing all materials, supplies, equipment and labor in accordance with the requirements set forth herein and as shown on the drawings.

1.2 APPLICABLE CODES, STANDARDS AND SPECIFICATIONS: The work under this Contract shall be in strict accordance with the following codes and standards.

1.2.1 All Local, County, Municipal and Federal Codes.

1.2.2 American National Standards Institute (ANSI).

1.2.3 American Society for Testing and Materials (ASTM).

1.2.4 American Water Works Association (AWWA).

1.2.5 American Association of State Highway and Transportation Officials (AASHTO).

1.2.6 Florida Department of Transportation Standard Specifications for Road and Bridge Construction (DOT).

1.2.7 Recommended Standards for Wastewater Facilities, (10-States Standards).

1.2.8 Florida Dept. of Environmental Protection

1.3 QUALITY ASSURANCE STANDARDS:

1.3.1 American National Standards Institute, Inc. (ANSI)/American Water Works Association (AWWA):

1. ANSI/AWWA C105, Polyethylene Encasement for Ductile - Iron Piping for Water and Other Liquids.
2. ANSI/AWWA C110, Ductile-Iron and Gray-Iron Fittings, 3 In. through 48 In., for Water and Other Liquids.
3. ANSI/AWWA C111, Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.

4. ANSI/AWWA C115, Flanged Ductile-Iron Pipe with Threaded Flanges.
5. ANSI/AWWA C150, Thickness Design of Ductile-Iron Pipe.
6. ANSI/AWWA C151, Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds for Water or Other Liquids.
7. ANSI/AWWA C153, Ductile Iron Compact Fittings, 3-inch through 16 inch, for water and other liquids.
8. AWWA C600, Installation of Ductile-Iron Water Mains and Their Appurtenances.
9. AWWA C605 Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water

1.3.2 American Society for Testing and Materials (ASTM):

1. ASTM C828, Standard Practice for Low-Pressure Air Test of Vitrified Clay Pipe Lines.
2. ASTM D2321, Standard Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.
3. ASTM D2412, Standard Practice for external loading properties of plastic pipe by parallel plate loading.
4. ASTM D2444, Standard Test Method for determination of the impact resistance of thermoplastic pipe and fittings by means of a TUP (falling weight).
5. ASTM D3034, Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
6. ASTM D3212, Joints for Drain and Sewer Pipes using Flexible Elastomeric Seals.
7. ASTM F477, Standard Specification for Elastomeric seals (gaskets) for joining plastic pipe.
8. ASTM F679, Standard Specification for Poly (Vinyl Chloride) (PVC) large diameter plastic gravity sewer pipe and fittings.

1.3.3 Manufacturer's name and model numbers are listed to establish a standard of quality. Equivalent items of other manufacturers are acceptable.

1.4 SUBMITTALS:

- 1.4.1 Submit manufacturer's certification of materials' conformance to specifications.
- 1.4.2 Submit manufacturer's literature, catalog data and installation instructions.
- 1.4.3 Submit certified field pressure test reports.
- 1.4.4 Submit pipeline video testing results.
- 1.4.5 Submit as-built drawings of completed system.

1.5 PRODUCT DELIVERY AND HANDLING:

- 1.5.1 Exercise care to prevent damage of product during loading, transporting, unloading and storage.
- 1.5.2 Do NOT drop pipe or fittings.
- 1.5.3 Do not store directly on ground and assure that materials are kept clean. Pipe shall be kept bundled and strapped until it is ready for installation in order to prevent warping or disfiguring.
- 1.5.4 Store material in areas approved by the Owner.
- 1.5.5 Store material in such a manner as to not create a nuisance or safety hazard.

2. PRODUCTS:

2.1 PIPE:

2.1.1 General: Pipe shall be furnished free from defects impairing strength and durability and should be of best commercial quality for purpose specified. Structural properties shall be sufficient to safely sustain or withstand strains to which it is normally subjected.

2.1.2 Pipe Materials:

1. Polyvinyl Chloride (PVC):

- a. Specification: ASTM D3034 (4 Inch through 16 Inch)  
ASTM F679 (18 Inch through 48 Inch)

- b. Thickness: SDR 35 for sewers up to 12 feet deep, SDR 26 for sewers over 12 feet deep.
- c. All PVC gravity sewer pipe is to be green in color and have “Sewer” permanently marked on each joint.

2.1.3 Pipe Joints:

- 1. Polyvinyl Chloride: Push On: ASTM D3212.

2.2 PIPE FITTINGS:

2.2.1 Ductile Iron:

- 1. ANSI/AWWA C110, Ductile Iron Fittings.
- 2. ANSI/AWWA C153, Ductile Iron Compact Fittings.
- 3. Lining: 40 mils Protecto 401 Epoxy or equal.
- 4. Mechanical: ANSI/AWWA C111.
- 5. Push On: AWSI/AWWA C111.
- 6. Flanged: ANSI B16.1, 125 lb.
- 7. Thickness: Match class of gravity main.

2.2.2 Polyvinyl Chloride:

- 1. ASTM D3034, PVC Bell and Spigot Fittings.
- 2. ASTM D3212, Joints.
- 3. Thickness: Match SDR of gravity main.

2.3 FLOWABLE FILL:

2.3.1 General: Excavatable Flowable Fill shall be provided for filling abandoned gravity sewers.

2.3.2 FDOT Standard Specifications for Road and Bridge Construction, Section 121.

2.4 CONCRETE:

2.4.1 Benches and Flowchannels: 4,000 psi 28 day mix, Type II Cement.

2.4.2 Encasement: 3,000 psi 28 day mix, Type I or II Cement.

3. INSTALLATION:

3.1 EXCAVATION:

3.1.1 General: The Contractor shall perform all excavation of every description and of whatever substances encountered to the depths indicated on the drawings or as necessary. This shall include all necessary clearing and grubbing of any foreign substance encountered within the structure or trench area. Excavated material suitable for backfill shall be piled in an orderly manner at a sufficient distance from the trench to prevent slides or cave-ins.

3.1.2 Protection of Existing Facilities and Utilities: All existing improvements such as pavements, conduit, poles, pipes and other structures, shall be carefully supported and fully protected from injury and, in case of damage, they shall be restored by the Contractor without compensation. Existing utilities and other underground obstructions are shown on the plans, but the accuracy of the locations and depths is not guaranteed. The Contractor shall contact all utilities prior to construction and arrange for the necessary assistance in locating and protecting the existing utilities. The Contractor shall be responsible for damages to these existing utilities and shall, in case they are damaged, restore them to their preconstruction or better condition.

3.1.3 Trench Excavation: The minimum width of the trench shall be equal to the outside diameter of the pipe at the joint plus 8 in. each side of pipe for unsheeted or sheeted trench, with the maximum width of trench, measured at the top of the pipe, not to exceed the outside pipe diameter, plus 24 in., unless otherwise shown on the drawings. Trench walls shall be maintained vertical from the bottom of the trench to a line measured one foot above the top of the pipe. From the top of the pipe to the surface of the trench walls shall be as vertical as possible under soil conditions.

No more than 300 linear feet of trench shall be open in advance of the completed pipe laying operation without prior approval of the Engineer. Pipe trenches across roadways and driveways shall be backfilled as soon as the pipe is installed. Where, in the opinion of the Engineer, adequate detour facilities are not available, no trench shall be left open across a roadway or commercial property driveway where adequate detour routes are not available for a period in excess of 30 minutes, or as directed by

the governing authority. No trench shall be left open across any roadway or driveway for more than 24 hours. It shall be the Contractor's responsibility to provide traffic control and barricades as necessary.

- 3.1.4 Shoring, Sheeting and Bracing: The Contractor shall design, furnish, and install all shoring, sheeting and bracing or provide other approved facilities required to perform and protect the excavation and as necessary for the safety of the public, the employees, and the preservation of existing roads, structures and other utilities. The top of such sheeting left in place shall be cut off at a minimum elevation of 2.5 ft. below finished grade. All work shall be in accordance with the Florida Trench Safety Act.
- 3.1.5 Pavement Removal: The Contractor shall remove pavements as part of the trench excavation. The material from permanent pavement removal shall be carefully separated from trench excavation material and disposed of by the Contractor.
- 3.1.6 Boulder Removal: All rocks, stones, boulders or concrete, having any dimension larger than permitted to be used for backfill in the paragraph entitled "Backfilling" of these Specifications, shall be removed from the site and disposed of by the Contractor.
- 3.1.7 Unsuitable Soil Conditions and Overdepth Excavation: In the event the project encounters unsuitable materials, the Contractor shall construct an adequate foundation to support the pipe.
1. Foundation shall consist of 4" of granular fill (No. 57 stone) or 8" of A-3 sand (ASTM D2321, Class II) compacted to 95% of maximum density (ASSHTO T 180).
  2. Where granular fill foundations are used, bedding material shall be added to fill voids in foundation material prior to constructing required bedding depth.
  3. Granular fill foundation shall be overlain by 4" of bedding material. Bedding material shall be A-3 sand (ASTM D2321, Class II).
  4. Shape bedding material to receive pipe bells and support 1/4 of the pipe surface.
  5. Limits of overexcavation shall be determined by a qualified geotechnical observer or as described on the drawings.

6. Compensation shall be in accordance with Measurement and Payment section of this document.

3.1.8 Disposal of Excess Material: The Contractor shall dispose of the excavated materials not required or suitable for backfill. All surplus excavated material which is unsuitable for fill shall become the property of the Contractor and shall be disposed of by the Contractor at his expense. Pieces of broken asphalt shall be carefully separated from suitable fill material and hauled to an asphalt plant for disposal or shall be disposed of by some other acceptable means by the Contractor at no expense to Owner. All excavated material not suitable for backfill (e.g., concrete, boulders, roots, etc.) shall be carefully separated from suitable fill material and disposed of by the Contractor at no expense to Owner. Owner has first right of refusal to accept suitable backfill material from the Contractor at no cost to the Owner.

### 3.2 INSTALLATION OF GRAVITY SEWERS AND SERVICES:

3.2.1 Manufacturer's Instructions: Gravity sewer pipe shall be handled, stored and installed in strict accordance with the pipe manufacturer's instructions. A copy of the manufacturer's instructions shall be kept at the site of the work at all times by the Contractor.

3.2.2 Pipe Laying: The trench shall be excavated as specified and the bottom of the trench shall be shaped to give sufficient uniform circumferential support to the lower, one-fourth of each pipe. Pipe laying shall proceed upgrade. Each pipe shall be laid true to line and grade. As the work progresses, the interior of the pipe shall be cleaned of all dirt and superfluous materials.

Where cleaning of the pipe after laying is difficult because of the small diameter, the Contractor shall keep a suitable swab or drag in the pipe and shall pull the swab forward past each joint immediately after the jointing operation. At all times when the work is not in progress on the sewer lines, the Contractor shall securely seal the open ends of all pipes in order to prevent the entrance of foreign matter. Stoppers shall be installed in the ends of all services.

In the event that it is necessary to clean the pipe by flushing with water, no water or debris shall be permitted to enter an existing or previously approved sewer. Under no conditions shall the water and debris be removed with lift station pumps or discharged into or through force mains.

3.2.3 Jointing: The bell and spigot surfaces shall be wiped free of dust, dirt, gravel or other foreign material before the application of the lubricant sealer. The resilient joint shall be connected by first brushing upon the mating surfaces the proper lubricant sealer as recommended by the pipe manufacturer. The spigot end shall then be centered on grade into the bell end of the last downstream pipe length and shoved home and properly seated with the application of moderate force by a pry or lever device. The pipes shall be jointed no later than five minutes after the application of the lubricant sealer. Jointing for connections with existing mains, or other special joints, shall be approved by the Engineer before use.

3.2.4 Building Service Laterals:

1. Contractor shall provide all pipe and fittings necessary to install sewer laterals from point of connection at 8-inch PVC gravity sewer to property line.

3.2.5 Connections to Existing Manholes: Pipe connections to existing manholes shall be made so that finished work will conform as nearly as possible to essential requirements for new manhole construction. This shall include core drilling manhole, installing flexible boot connector and reconstructing the existing concrete benches and flow channel.

3.2.6 Quality Assurance: It is the responsibility of the Contractor to install the gravity sewer pipe as shown on the plans. Prior to backfilling, the Contractor shall survey each gravity sewer section (i.e. manhole to manhole) to determine actual invert elevations and slope of the pipe. Invert elevations must be within  $\pm 0.05$  ft. of design invert elevations. Resulting calculated minimum pipe slope shall be as follows, depending on diameter of gravity sewer:

<u>Gravity Sewer Diameter (in)</u>	<u>Minimum Allowable Slope</u>
4	0.85%
6	0.50%
8	0.35%
10	0.25%
12	0.20%
15	0.15%
18	0.12%
21	0.10%
24	0.10%



Contractor shall provide invert elevations to Engineer or his representative each day to verify above requirements are met. If invert elevations and/or calculated pipe slopes do not meet requirements, Contractor shall remove and reinstall gravity sewer pipe and/or manholes such that the above requirements are met, at his own expense. See Paragraph 3.05 for gravity sewer testing requirements.

### 3.3 SEPARATION REQUIREMENTS BETWEEN GRAVITY SEWERS AND POTABLE WATER/RECLAIMED WATER MAINS:

3.3.1 Horizontal Separation: Gravity sewers shall be laid at least six (6) feet (outside to outside) horizontally from water mains and at least three feet (outside to outside) horizontally from any existing or proposed reclaimed water line. Smaller horizontal separation distances for gravity sewers are allowed if one or more of the following conditions is met:

1. The top of the gravity sewer is installed at least 12-inches below the bottom of the potable water line.
2. The gravity sewer is encased in watertight carrier pipe or concrete.
3. Both the gravity sewer and the water main are constructed of slip-on or mechanical joint pipe complying with public water supply design standards and pressure tested to 150 psi to assure watertightness.

3.3.2 Vertical Separation: Gravity Sewers shall cross under water mains, unless there is no alternative. Gravity sewers crossing water mains or reclaimed water lines shall be laid to provide a minimum vertical distance of 12-inches between the invert of the upper pipe and the crown of the lower pipe. The minimum vertical separation shall be maintained whether the water main is above or below the gravity sewer. For sewer crossings, the crossing shall be arranged so that the gravity sewer pipe joints are equidistant and as far as possible from the water main joints. Adequate structural support shall be provided for the gravity sewer to maintain line and grade. For gravity sewers, smaller vertical separation distances if one of the following conditions are met.

1. The gravity sewer is encased in a watertight carrier pipe or concrete.
2. The gravity sewer is designed and constructed equal to water pipe and pressure tested to 150 psi to assure watertightness.

No vertical or horizontal separation distances are required for above-ground crossings.

3.3.3 Concrete Encasement of Pipe: Where concrete encasement of pipe is required for obtaining separation from other pipes or for other reasons (e.g., inadequate cover), the pipe shall be encased with 3,000 psi concrete having a minimum thickness of 6 inches all around the outside of the pipe. Pipe must be supported in trench to allow 6 inches of concrete on all sides. Concrete must be mechanically vibrated into place. The Engineer or his representative must be present at the time of encasement.

3.3.4 Contractor shall notify Engineer immediately where separation criteria cannot be met.

#### 3.4 BACKFILLING:

3.4.1 Material: All backfill shall be excavated material, essentially free of organic material, asphaltic concrete, clay, concrete, boulders and other deleterious material.

1. Bedding and Pipe Embedment to 12" Above Top of Pipe: The Contractor shall furnish, place, and compact AASHTO Class A-3 sandy material containing less than 1% of organics or other unsuitable material.
2. Above Pipe Embedment: The material shall be AASHTO Class A-3 material or AASHTO Class A-2-4 with prior approval from the Engineer. If the Contractor elects to use A-2-4 material, stringent moisture control will be required during the placement to achieve the required compaction, particularly during rainy periods which could cause delays in construction time.
3. Top of Backfill: The top 12 inches of the backfill shall be topsoil and/or AASHTO Class A-3 material with mixed organics.
4. Additional Fill: If sufficient suitable backfill material is not available from the excavation, additional fill meeting the above requirements shall be provided by the Contractor at no expense to the Owner.
5. If deemed necessary by Engineer or his representative, backfill shall be tested for compliance with above requirements prior to placement.

### 3.4.2 Placing and Compaction:

1. Bedding and Pipe Embedment: The backfill shall be placed by hand under and around the pipe to the springline and compacted. Particular care shall be taken to ensure that the backfill at the pipe haunch is free from voids and is properly compacted. The backfill shall be compacted to a density of not less than 98% of maximum as determined by AASHTO T 180.
  - a. Above Pipe Embedment in Areas of Permanent Pavement: The backfill shall be placed in layers having a depth that will permit proper compaction but not exceeding 8" of loose measure. The backfill shall be compacted to a density of not less than 98% of maximum as determined by AASHTO T 180.
  - b. Above Pipe Embedment In Areas Not Under Permanent Pavement: Within right-of-ways or other areas where permanent pavement does not exist or is not proposed, (including roads, walks and driveways consisting of broken stone, gravel, clay, marl, shell, shellrock or conglomerate), the entire backfill above the pipe embedment to the subgrade of the pavement or structures shall be made with predominantly sandy material free from rock, stones or organic matter, except that rocks having a maximum dimension of 3 ½ inch will be permitted in the backfill between the elevation 1 ft. above the top of the pipe and 1 ft. below the surface. The backfill material above 1 ft. over the pipe shall be compacted to a density of not less than 90 percent of the maximum density, as determined by AASHTO T 180.
2. In areas where unpaved, stabilized roads exist, the Contractor shall restore the road to its original grade and condition. The finished stabilized road shall have a minimum LBR value of 50 for the top 12" of the roadbed.
3. Miscellaneous: Backfilling around manholes, cleanouts and other structures shall be accomplished in the same manner as the connected pipe. Extreme care shall be used in backfilling wellpoint holes to prevent voids and settlement. If necessary, the holes should be plugged with a concrete slurry, such plugging to be at the expense of the Contractor.

4. Compaction: Shall be by hand or by mechanical tampers. Care shall be taken that the pipe is not struck by the tamper. Compaction by flooding may be allowed by written authorization of the Engineer although this will not release the Contractor of the responsibility to meet the required density.
5. The Contractor is to compact the backfill in such a manner to prevent settlement. Although the requirements of 3.04 may be met, nonsettlement is not assured and Contractor is not relieved of his responsibility by such compliance.
6. PVC Pipe shall be laid and backfilled so that pipe deflection does not exceed five (5) percent.
7. The Contractor shall perform density tests at 1 foot elevation increments, starting at the base of the pipe at the following locations:
  - a. Within 20 feet of each manhole.
  - b. At a point halfway between manholes.
  - c. At every road lane crossing.
8. The Contractor shall perform LBR Test at a minimum of 300' on center.

### 3.5 TESTING:

- 3.5.1 Flushing of Completed Pipelines: Each section of completed pipeline shall be as thoroughly flushed as is possible. A minimum flow shall be used for flushing that will insure a velocity in the pipe of 2.5 ft. per second. Water required for testing and flushing shall be furnished by the Owner at existing pipes and outlets. Contractor shall be responsible for removal of all dirt and debris from all manholes/wetwells prior to Owner's acceptance.
- 3.5.2 The Contractor shall furnish all necessary equipment and labor to perform testing of all gravity sewers as set forth in the following and shall conduct such tests in the presence of the Engineer and other authorized agencies, with five days advance written notice provided.
- 3.5.3 All newly installed gravity sewers shall be televised. Televising shall occur immediately after sewers have been flushed so that areas of standing water can be observed.

1. The television camera used for the survey shall be one specifically designed and constructed for such survey with tilt and pan capabilities. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. The camera shall be operative in 100% humidity conditions. The camera, television monitor, and other components of the video system shall be capable of producing a clear color video picture. The video camera shall include a title feature capable of showing on the recording the following information:

■ Comment	■ Client
■ Line Type	■ Line Number
■ Date	■ Line Size
■ Street Name	■ Tape Index
■ Contractor's Name	■ Ongoing Footage Counter
■ TV Direction	■ Tape ID Number
■ Manhole Identification (both manholes)	

Camera shall be equipped with a device capable of measuring dips in the pipe in 1/4-inch increments.

2. The video recording company shall prepare the final recording on DVDs for use by the Owner and the Engineer. A total of two sets shall be furnished on a 4.7 GB format DVD, suitable for playing on a standard DVD player or computer DVD drive.

The disk shall be bookmarked with a separate chapter title for each street that was recorded or with chapter bookmarkings at fixed three minute or five minute intervals. The DVDs shall not be copy righted or copy protected such that the Owner or Engineer will have the ability to make additional copies if necessary.

3. The camera shall be moved through the line, stopping when necessary to permit proper documentation of the sewer joint, lateral, defect or repair. In no case shall the television camera be pulled at a speed greater than 30 feet per minute. All sewer laterals shall be inspected using the camera tilt and pan features. At least 10 seconds of focused observation shall be included on

each lateral. A measuring device visible to the camera shall be part of the equipment pulled through the pipe.

4. Any dips in the gravity sewer holding more than  $\frac{5}{8}$ " water shall be deemed defective and shall be corrected at Contractor's expense.
- 3.5.4 The installed sewers shall be visually inspected by "lamping" between manholes, lampholes or other structures in order to ascertain that they are clear and to correct alignment. The concentricity of the lamp image received shall be such that the diameter of said image shall have no vertical or horizontal reduction from that of the pipe inside diameter.
  - 3.5.5 The watertightness of a sewer which has a crown lying below groundwater level shall be tested by measuring the infiltration. The watertightness of sewers having a crown 1 inch or more above groundwater level shall be tested by filling the pipe with water to produce a hydrostatic head of 2 feet or more above the crown of the sewer at the upper end of the test section or the water table outside of the sewer, whichever is higher, and then measuring the exfiltration. In no case shall the infiltration or exfiltration exceed 75 gallons per mile per inch of diameter of sewer per 24-hour day when field tested by actual infiltration conditions. If exfiltration testing is required an allowance of an additional 10 percent of gallonage shall be permitted for each additional 2-feet head over a basic 2-feet minimum internal head.
  - 3.5.6 Leakage testing shall proceed for a continuous period of eight hours with exfiltration or infiltration amounts measured by methods approved by the Engineer. Upon application of internal hydrostatic pressure for exfiltration testing, care shall be taken to preclude unseating the joint gaskets for a specific type of pipe by exceeding the pressure capability thereof.
  - 3.5.7 The Contractor may use, as an alternate leakage test, air testing by compressed air from manhole to manhole. Plugs, caps and branch connections must be secured against blow-off during the test. The pipe and manholes shall be free of water during the test.
    1. The air testing shall be performed in accordance with ASTM C828 for Vitrified Clay Pipe of Sizes 4 Inch through 12 Inch.
    2. Laterals shall be temporarily plugged and manhole to manhole pipe brought to a stable 3.5 psig air pressure.
    3. Air supply hose shall be shut off and time recorded.

4. Pipe section shall be acceptable if time to drop from 3.5 psig to 2.5 psig is less than or equal to one half the pipe diameter, in minutes.
- 3.5.8 Deflection Testing: The Contractor shall perform deflection tests of the pipe along the entire length of the sewer main. The internal diameter of the barrel shall not be reduced by more than five percent (5%) of its base inside diameter when measured not less than thirty (30) days following completion of installation. A deflection of more than the specified amount shall be cause for rejection of that particular segment of pipe located between successive manholes. All locations with excessive deflection shall be excavated and repaired by rebedding or replacement of the pipe. A properly sized nine (9) point go-no-go mandrel shall be used for testing the sewer. Adjustable mandrels shall not be acceptable. Deflection testing for pipe under roadways shall be performed after road base is complete.
  - 3.5.9 Should any of the test fail, necessary repairs shall be accomplished by the Contractor and the test repeated until within the established limits. The Contractor shall furnish the necessary labor, and all other items required to conduct the required testing, and shall perform the necessary system repairs required to comply with the specified test.
  - 3.5.10 No installation of roadway base or paving shall occur over a gravity sewer until said section of sewer has passed all required testing including televising, lamping, leakage, and deflection.
- 3.7 PROTECTION:
    - 3.7.1 At the end of each work day, the mains under construction shall be plugged to prevent the entry of small animals and rodents. Temporary plugs shall be provided for this purpose.
    - 3.7.2 Open trenches shall be backfilled at the end of each work day.
- 3.8 RESTORATION OF DAMAGED SURFACES, STRUCTURES, AND PROPERTY: Where pavement, trees, shrubbery, fences, or other property and surface structures not designated as pay items have been damaged, removed, or disturbed by the Contractor, whether deliberately or through failure to carry out the requirements of the contract documents, state laws, municipal ordinances, or the specific directions of the Engineer, or through failure to employ usual and reasonable safeguards, such property and surface structures shall be replaced or repaired at the expense of the Contractor to a condition equal to that before work began within a time frame approved by the Engineer.

### 3.9 RESTORATION AND CLEANUP:

#### 3.9.1 Restoration:

1. General: Restoration of areas disturbed by the Contractor's operations shall begin as soon as practical. Contractor's restoration operations shall keep pace with utility installation. Engineer reserves the right to halt utility installation until restoration and cleanup requirements are satisfied.
2. Time Frame for Restoration: Restoration of areas disturbed by the Contractor's operations shall begin no later than 14 days and shall be completed (excluding punch list items) no later than 28 days from the time construction first began in the area. No more than 1,000 LF along the path of the work may be completely unrestored (excluding punch list items) at the end of each day.

#### 3.9.2 Cleanup:

1. The Contractor shall maintain the site of the work in a neat condition.
2. The Contractor shall remove all excess materials and all debris resulting from his operations a minimum of once per week.
3. Excess suitable fill not used in performance of the Work shall first be offered to the Owner. Upon refusal of the fill by the Owner, excess fill shall be removed from the site at the Contractor's expense.

END OF SECTION



## SECTION 33 41 00

### PIPE WORK - STORM SEWER

#### 1. GENERAL:

- 1.1 DESCRIPTION: Work under this Section consists of furnishing all materials, supplies, equipment and labor in accordance with the requirements set forth herein and as shown on the drawings.
- 1.2 RELATED DOCUMENTS: The General Provisions of the Contract, including the General Conditions, Supplementary Conditions and Special Conditions (if any), along with the General Requirements, apply to the work specified in this Section.
- 1.3 APPLICABLE CODES, STANDARDS AND SPECIFICATIONS: The work under this Contract shall be in strict accordance with the following codes and standards.
  - 1.3.1 All Local, County, Municipal and Federal Codes.
  - 1.3.2 American National Standards Institute (ANSI).
  - 1.3.3 American Society for Testing and Materials (ASTM).
  - 1.3.4 American Water Works Association (AWWA).
  - 1.3.5 American Association of State Highway and Transportation Officials (AASHTO).
  - 1.3.6 Florida Department of Transportation Specifications (DOT).
  - 1.3.7 St. Johns River Water Management District. (SJRWMD).
  - 1.3.8 Florida Dept. of Environmental Protection. (FDEP).
- 1.4 REFERENCED CODES AND STANDARDS:
  - 1.4.1 American Association of State Highway & Transportation Officials (AASHTO)/ American Society for Testing and Materials (ASTM):
    - 1. ASTM C76/ AASHTO M 170, Round Reinforced Concrete Pipe.
    - 2. ASTM C443 / AASHTO M 198, Joints for Circular Concrete Sewer and Culvert Pipe with Rubber Gaskets.

3. ASTM C497, Determining Physical Properties of Concrete Pipe or Tile.
4. ASTM C507/AASHTO M 207, Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe.
5. ASTM C655/AASHTO M 242, Reinforced Concrete D-Load Culvert, Storm Drain and Sewer Pipe.
6. ASTM D1248, Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.
7. ASTM D2321, Standard Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.
8. ASTM D3350, Standard Specification for Polyethylene Plastics Pipe and Fitting Materials.
9. AASHTO M 252, Specification for Corrugated Polyethylene Drainage Tubing, 3 to 10 Inch Diameter.
10. AASHTO M 294 Type S, Specification for Corrugated Polyethylene Pipe, 12 to 36 Inch Diameter.
11. ASTM F405, Standard Specification for Corrugated Polyethylene Tubing and Fittings, 4" to 8" diameter.
12. ASTM F667, Standard Specification for Large Diameter Corrugated Polyethylene Tubing and Fittings, 10" to 24" diameter.
13. ASTM F477, Standard Specification for Elastomeric Seals.
14. AASHTO M 294, Standard Specification for Corrugated Polyethylene Pipe, 12" to 24" diameter.
15. AASHTO M 190, Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches.
16. ASTM A798, Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications.
17. ASTM A760/AASHTO M 36, Metallic (zinc or aluminum) Coated Corrugated Steel Culverts.
18. AASHTO M 196, Corrugated Aluminum Alloy Culverts and Underdrains.

19. ASTM A762, AASHTO M 245, Precoated, Galvanized Steel Culverts and Underdrains.
20. ASTM C139, Concrete Masonry Units for Construction of Catch Basins and Manholes.
21. ASTM C150, Portland Cement.
22. ASTM C443, Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
23. ASTM C478, Precast Reinforced Concrete Manhole Sections.
24. ASTM C1433, Precast Reinforced Concrete Box Sections for Culverts, Storm Drains and Sewers.
25. ASTM C923, Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes and Materials.
26. ASTM F2306/F2306M Standard Specification for 12 to 60 in. [300 to 1500 mm] Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications

1.4.2 Manufacturer's name and model numbers are listed to establish a standard of quality. Equivalent items of other manufacturers are acceptable.

#### 1.5 SUBMITTALS:

- 1.5.1 Submit manufacturer's certification of materials' conformance to specifications.
- 1.5.2 Submit manufacturer's literature, catalog data and installation instructions.
- 1.5.3 Precasters shop drawings indicating all dimensions, finishes, reinforcement and accessories for each unit.
- 1.5.4 As-built drawings in compliance with Section 01 71 00. As-built drawings of the drainage system shall be provided prior to making permanent above pipe improvements.

#### 1.6 PRODUCT DELIVERY AND HANDLING:

- 1.6.1 Exercise care to prevent damage of product during loading, transporting, unloading and storage.

- 1.6.2 Do NOT drop pipe or fittings.
- 1.6.3 Do not store directly on ground and assure that materials are kept clean.
- 1.6.4 Store material in areas approved by the Owner.
- 1.6.5 Store material in such a manner as to not create a nuisance or safety hazard.

1.7 QUALITY CONTROL:

- 1.7.1 Contractor shall make a timely submittal of as-built drawings of the stormwater system and prior to making permanent above pipe improvements.
- 1.7.2 Installed pipe slopes shall not deviate by more than 5% of the specified slope for each run.
- 1.7.3 Structure inverts and control elevations shall not deviate by more than 0.10 feet from the specified elevation.
- 1.7.4 Pipe slopes and inverts not meeting the standards of this section shall be relaid to the required slope or invert at the contractor's expense. Failure to correct a deficient item shall be cause for the contractor to forfeit payment for the materials and installation costs incurred for the item.

2. MATERIALS:

2.1 PIPE:

2.1.1 General: Pipe shall be furnished free from defects impairing strength and durability and should be of best commercial quality for purpose specified. Structural properties shall be sufficient to safely sustain or withstand strains to which it is normally subjected.

2.1.2 Pipe Materials:

- 1. Reinforced Concrete Circular Pipe (RCP) and Elliptical Pipe (ERCP):
- 2. Specification: ASTM C76 (RCP), C507 (ERCP).
- 3. Thickness: Class III, minimum.
- 4. Reinforcing: 65 ksi: Steel mesh.

### 2.1.3 Corrugated Polyethylene Pipe (CPP):

1. Specification: AASHTO M 294, ASTM F405, ASTM F667, AASHTO M 252, ASTM F2306.
  - b. Advanced Drainage Systems Air Chamber N-12 WT “watertight pipe” or approved equal.
  - c. Dual wall HDPE pipe with smooth interior lining and exterior corrugations.
  - d. Provide manufacturer installed “anti-float” perforations.
3. PVC Underdrain (UD):
  - a. Specification: CPP pipe with ASTM F405 underdrain slots.
  - b. Advanced Drainage Systems N-12 WT “watertight pipe” or approved equal.
  - c. Single wall, corrugated pipe material with integrated silt fabric or sock.
4. Corrugated Metal Circular Pipe and Arch Pipe (CMP):
  - a. Specification: AASHTO M 190
  - b. Galvanized steel with Interior & Exterior Bituminous Asphalt Coating, meeting AASHTO M 190, type A.
  - c. Aluminized Steel without coatings

### 2.1.2 Pipe Joints:

1. Reinforced Concrete Pipe (RCP & ERCP):
  - a. Bell & Spigot with Rubber Gaskets: ASTM C443.
2. Corrugated Polyethylene Pipe (CPP):
  - a. Couplings: ASTM F405, ASTM D3212, ASTM F1417.
  - b. All joints shall be rated as Water Tight.

3. PVC Underdrain (UD):
  - a. Push on: ASTM D3212
  - b. All joints shall be rated as Soil Tight.
4. Corrugated Metal Pipe and Arch Pipe:
  - a. Gaskets: ASTM D1056, Type 2
  - b. Connecting Bands: Materials shall be the same as the pipe. Gage, width, angles and fasteners shall be as specified by manufacturer.

#### 2.1.3 Filter Fabric:

1. Specification: FDOT Specification Section 985 (Geotextile Fabrics).
2. Class D-3 Material.

## 2.2 PRECAST UNITS:

### 2.2.1 Manholes, Inlets and Catch Basins:

1. Manholes, inlets and catch basins shall be constructed of precast reinforced concrete rings, precast reinforced sections, or cast-in-place concrete. Manholes, inlets and catch basins shall be in accordance with State of Florida Department of Transportation standard details.
  - a. Precast Reinforced Concrete Rings: Rings or sections shall have an inside diameter as indicated on the drawings, and shall be not less than 48 inches in diameter. Wall thickness shall conform to requirements of ASTM C76, except that lengths of the sections may be shorter as conditions require. Tops shall conform to ASTM C478. Top section shall be eccentric cone type.
  - b. Precast Reinforced Concrete Manhole Risers and Tops: Design, material and installation shall conform to requirements of ASTM C478. Top sections shall be eccentric.
  - c. Flat top manhole tops shall be reinforced concrete as detailed on the drawings.

- d. Precast Catch Basins: Concrete for precast sections shall have a minimum compressive strength of 4,000 psi at 28 days, ASTM A615, Grade 60 reinforcing steel, rated for AASHTO HS20-44 loading with 30 percent impact, and conform to ASTM C857.
- e. Brick Mortar: Precast Reinforced Concrete Ring and Riser Structures: By volume, 1 part of Portland cement and 2 parts sand. Water in mixture shall produce a stiff, workable mortar, but shall not exceed 5-1/2 gallons per sack of cement.
- f. Frames and covers shall be cast iron conforming to ASTM A48.
  - (1) The frame and cover shall be rated for HS20-44 loading, have a studded pattern on the cover with the Owner's name and the words "storm sewer" stamped into the surface. The studs and the lettering shall be raised 5/16 inch.
  - (2) The cover shall be a minimum of 24 inches in diameter and shall have four 3/4 inch vent holes and two lifting slots. The bearing surface of the frame and cover shall be machine finished. The cover shall fit firmly on the frame without movement when subject to traffic.
- g. Grates shall be cast grey iron conforming to ASTM A48 in accordance with Florida Department of Transportation standard details. The grate shall fit firmly on the frame without movement when subject to traffic.
  - 1. All grates shall be traffic rated for HS20-44 loading.
  - 2. All grates shall be fitted with an eyebolt and chain secured to the concrete to prevent unauthorized removal.
  - 3. The shape and size of waterway openings shall be as shown on the drawings
- h. Flexible sealing compound shall be packaged in extruded preformed shape, sized to completely fill the joint between precast sections, and form permanently flexible watertight seal. The sealing compound shall be non-shrink and meet AASHTO M 198B.

2.2.2 Adjusting Brick and Rings:

1. Brick: Sound, hard and uniform shape. Comply with ASTM C32, Grade MM.
2. Rings: Pre-case unit complying with ASTM C478.

2.2.3 Mortar: Metallic non-shrink mortar applied and cured in conformance with the manufacturers recommendations. EMBECO 167 or equal.

2.2.4 Headwalls & Mitered End Sections:

1. Headwalls and mitered end sections shall be cast-in-place or precast concrete and in accordance with Florida Department of Transportation standard details.
2. Concrete shall be in accordance with State Department of Transportation standard specifications. Concrete shall have a minimum compressive strength of 4,000 psi at 28 days. The cement shall be Type II conforming to ASTM C150.

2.2.5 Reinforcing Steel: Reinforcing steel shall be deformed bars, ASTM A615, Grade 60 unless otherwise noted.

2.3 PREFABRICATED PLASTIC MANHOLES AND DRAIN BASINS:

2.3.1 Plastic manholes and drainage basins shall be as indicated on the drawings.

2.3.2 Basis of design shall be Nyloplast Storm Drainage Structures

2.3.3 Grates shall be traffic rated and ductile iron (ASTM A536) or cast iron (ASTM A48).

2.3.4 Grates shall be Pedestrian Safe and fitted with a locking mechanism to prevent unauthorized removal.

2.3.5 All joints shall be water tight.

2.3.6 All grates shall receive a concrete collar as shown on the drawings.

2.4 RESILIENT CONNECTORS AND DOWNSPOUT BOOTS:

2.4.1 Resilient Connectors:

1. Connectors shall be boots or external gaskets.



2. Flexible, watertight connectors used for connecting flexible pipe to manholes and inlets shall conform to ASTM C923.

2.4.2 Downspout Boots: Boots used to connect exterior downspouts to the storm drainage system shall be a square to round adaptor as manufactured by Fernco, Advanced Drainage System or equal. Size to match downspout and collection pipe.

### 3. INSTALLATION:

#### 3.1 EXCAVATION:

3.1.1 General: The Contractor shall perform all excavation of every description and of whatever substances encountered to the depths indicated on the Drawings or as necessary. This shall include all necessary clearing and grubbing of any foreign substance encountered within the structure or trench area. Excavated material suitable for backfill shall be piled in an orderly manner at a sufficient distance from the trench to prevent slides or cave-ins.

3.1.2 Protection of Existing Facilities and Utilities: All existing improvements such as pavements, conduit, poles, pipes and other structures, shall be carefully supported and fully protected from injury and, in case of damage, they shall be restored by the Contractor without compensation. Existing utilities and other underground obstructions are shown on the plans, but the accuracy of the locations and depths is not guaranteed. The Contractor shall contact all utilities prior to construction and arrange for the necessary assistance in locating and protecting the existing utilities. The Contractor shall be responsible for damages to these existing utilities and shall, in case they are damaged, restore them to their original condition at no cost to the Owner.

3.1.3 Trench Excavation: The minimum width of the trench shall be equal to the outside diameter of the pipe at the joint plus 8 in. each side of pipe for unsheeted or sheeted trench, with the maximum width of trench, measured at the top of the pipe, not to exceed the outside pipe diameter, plus 24 in., unless otherwise shown on the drawings. Trench walls shall be maintained vertical from the bottom of the trench to a line measured at the top of the pipe. From the top of the pipe to the surface of the trench walls shall be as vertical as possible under soil conditions.

No more than 150 linear feet of trench shall be open in advance of the completed pipe laying operation without prior approval of the Engineer. Pipe trenches across roadways and driveways shall be backfilled as soon as the pipe is installed. Where, in the opinion of the Engineer, adequate detour facilities are not available, no trench shall be left open across a roadway or commercial property driveway where adequate detour routes are not available

for a period in excess of 30 minutes, or as directed by the governing authority. No trench shall be left open across any roadway or driveway for more than one daylight period. It shall be the Contractor's responsibility to provide traffic control and barricades as necessary.

- 3.1.4 Shoring, Sheeting and Bracing: The Contractor shall design, furnish, install, and maintain all shoring, sheeting and bracing or provide other approved facilities required to perform and protect the excavation and as necessary for the safety of the public, the employees, and the preservation of existing roads, structures and other utilities. The top of such sheeting left in place shall be cut off at a minimum elevation of 2.5 ft. below finished grade. All work shall be in accordance with the Florida Trench Safety Act. See Section 02300 for additional requirements.
- 3.1.5 Boulder Removal: All rocks, stones, boulders or concrete, having any dimension larger than permitted to be used for backfill in the paragraph entitled "Backfilling" of these Specifications, shall be removed from the site and disposed of by the Contractor.
- 3.1.6 Trash Removal: Non-hazardous waste material encountered within the trench section including, but not limited to, household solid waste, wood, tires, and plastic shall be removed from the site. Under no circumstances, shall this material be reburied.
- 3.1.7 Disposal of Excess Materials: The Contractor shall dispose of the excavated materials not required or suitable for backfill. All surplus excavated material which is suitable for fill shall become property of the Contractor and shall be disposed of by the Contractor at his expense.
- 3.1.8 Unsuitable Soil Conditions and Over Depth Excavation: Overexcavate and backfill as required by Section 310000.

### 3.2 INSTALLATION OF STORM SEWER PIPE:

- 3.2.1 Manufacturer's Instructions: Storm sewer pipe shall be handled, stored and installed in strict accordance with the pipe manufacturer's instructions. A copy of the manufacturer's instructions shall be kept at the site of the work at all times by the Contractor.
- 3.2.2 The trench shall be excavated as specified and the bottom of the trench shall be shaped to give sufficient uniform circumferential support to the lower, one-fourth of each pipe.
- 3.2.3 Pipe laying shall proceed upgrade.

- 3.2.4 Lay pipes true to line and grade. Gravity flow sewer shall be laid with bells facing upgrade.
- 3.2.5 Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.
- 3.2.6 Support pipe on compacted bedding material. Excavated bell holes only large enough to properly make the joint.
- 3.2.7 Inspect pipes and fittings, for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.
- 3.2.8 Clean interior of all pipe thoroughly before installation. When work is not in progress, open ends of pipe shall be closed securely to prevent entrance of storm water, dirt or other substances.
- 3.2.9 Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.
- 3.2.10 Where cleaning of the pipe after laying is difficult because of the small diameter, the Contractor shall keep a suitable swab or drag in the pipe and shall pull the swab forward past each joint immediately after the jointing operation.
- 3.2.11 Jointing: The bell and spigot surfaces shall be wiped free of dust, dirt, gravel or other foreign material before the application of the lubricant sealer. The resilient joint shall be connected by first brushing upon the mating surfaces, the proper lubricant sealer as recommended by the pipe manufacturers. The spigot end shall then be centered on grade into the bell end of the last downstream pipe length and shoved home and properly seated with the application of moderate force by a pry or lever device. The pipes shall be jointed no later than five minutes after the application of the lubricant sealer. Jointing for connections with existing mains, or other special joints, shall be approved by the Engineer before use.
  - 1. All joints shall be wrapped in a 30" wide layer of filter fabric. Fabric shall be centered on the joint and completely surround the pipe with a 18" lap.
- 3.2.12 Do not lay sewer pipe in same trench with another pipe or other utility unless authorized by the engineer.
- 3.2.13 Do not walk on pipe in trenches until covered by layers of fill to a depth of 12 inches over the crown of the pipe.

### 3.2.14 Connections to Manholes or Inlets:

1. Pipe connections to concrete manholes or inlets shall be made with resilient connectors.
2. Watertight gaskets shall be fitted to the pipe and embedded in the grouted annular space in accordance with the manufacturer's requirements.

3.2.15 It is the responsibility of the Contractor to install the stormsewer pipe as shown on the Drawings. The Contractor shall survey the newly installed line before backfilling to determine the actual invert elevations of the pipe. If the calculated slope is below the minimum acceptable requirements, the Contractor shall remove and relay the stormsewer pipe at his own expense before further installation continues. The Contractor shall submit the as-built information to the Engineer at the end of each work day. This information will be included in the daily inspection report. Constructed slopes shall not vary more than 5% from the design value.

### 3.3 PRECAST UNIT INSTALLATION:

3.3.1 Installing Sections: Precast concrete sections shall be set so the manhole will be vertical and with sections in true alignment. Joint surfaces of the base of previously set section shall have an O-ring installed in the recess or shall be sealed with pre-molded plastic joint sealer "RAMNEK." If "RAMNEK" is used, joints shall be pre-primed.

3.3.2 Non-Metallic Non-Shrink Grout: All holes in sections used for their handling, and the annular space between the wall and entering pipes shall be thoroughly plugged with Masterflow 713 Plus as manufactured by the BASF, or any approved equal non-shrinking mortar or grout, applied and cured in strict conformance with the manufacturer's recommendations, so that there will be zero leakage through openings and around pipes.

1. The mortar shall be finished smooth and flush with the adjoining interior and exterior manhole wall surfaces.
2. Non-concrete pipe connections shall be fitted with a resilient connector to provide a watertight connection between the pipe and the manhole.

3.3.3 Membrane Curing Compound: As soon as grout is hydrated to the point where it will not be marred by such application, and within two (2) hours after installing grout, the Contractor shall apply an approved membrane curing compound, conforming to ASTM C309, Type 1, Class B, to the finished mortar surfaces both inside and outside the manhole. Submission of

alternate mortars or grouts should include an alternate membrane curing compound or indicate which of the above approved products is proposed for use.

- 3.3.4 Grade Adjustment: For grade adjustment in setting the man-hole frame, brick masonry shall be used on top of manhole slabs and precast concrete manhole cones in accordance with the drawings. Mortar shall be one part cement and two parts sand; lime shall not be used.
- 3.3.5 Setting Manhole Frames: Manhole frames and covers shall be set to conform accurately to the finished ground or pavement surface as established by the Contract Drawings, unless otherwise directed by the Owner. Frames on manhole cones shall be set concentric with the masonry and in a full bed of mortar so that the space between the top of the manhole masonry and the bottom flanges of the frame shall be completely filled and made water tight. A ring of mortar at least one inch thick and pitched to shed water away from the frame shall be placed around the outside of the bottom flange. Mortar shall extend to the outer edge of the masonry and shall be finished smooth and flush with the top of the flange.
- 3.3.6 Flow Channels: Flow Channels in manhole base shall be formed of Class "C" concrete and/or brick rubble and mortar, while the manholes are under construction. Cut off pipes at inside face of the manhole and construct the invert to the shape and sizes of pipe indicated. All inverts shall follow the grades of the pipe entering the manholes. Changes in direction of the sewer and entering branch or branches shall be laid out in smooth curves of the longest possible radius which is tangent to the centerlines of adjoining pipelines.

#### 3.4 BACKFILLING:

- 3.4.1 Material: All backfill shall be suitable fill as described in Section 31 00 00 and as further described below:
  - 1. Bedding and Pipe Embedment: The material in the bedding, around the pipe and to a depth of 1 ft. over the pipe, shall be sand or a mixture of sand, shell or crushed stone properly graded and mixed so that fine grain material from the side walls of the trench or backfill above the embedment will not migrate into the backfill material. The backfill shall meet the following limitations.
    - a. Concrete Pipe: All material shall pass through a 3/4 in. square opening laboratory sieve.
    - b. Corrugated Metal and Plastic Pipe: All materials shall pass through a 1/2 in. square opening laboratory sieve.

2. Above Pipe Embedment: The material shall be suitable fill as described in Section 310000.
3. Top of Backfill: The top 6 inches of the backfill shall be topsoil (as defined in 310000 in areas to be landscaped or grassed).
4. Additional Fill: If sufficient suitable backfill material is not available from the excavation, additional fill meeting the above requirements shall be provided by the Contractor at no expense to the Owner.

#### 3.4.2 Placing and Compaction:

1. Bedding and Pipe Embedment: The backfill shall be placed by hand under and around the pipe to the springline and compacted. Particular care shall be taken to ensure that the backfill at the pipe haunch is free from voids and is properly compacted. The backfill shall be compacted to a density of not less than 98% of maximum as determined by AASHTO T 180.
  - a. Above Pipe Embedment in Areas of Permanent Pavement: The backfill shall be placed in layers having a depth that will permit proper compaction as described in Section 310000. The backfill shall be compacted to a density of not less than 98% of maximum as determined by AASHTO T 180.
  - b. Above Pipe Embedment In Areas Not Under Permanent Pavement: Within right-of-ways or other areas where permanent pavement does not exist or is not proposed the backfill material above 1 ft. over the pipe shall be compacted to a density of not less than 90% of the maximum density, as determined by AASHTO T 180.
2. In areas where unpaved, stabilized roads exist, the Contractor shall restore the road to its original grade and condition. The finished stabilized road shall have a minimum LBR value of 50 for the top 12" of the roadbed.
3. Miscellaneous: Backfilling around manholes, cleanouts and other structures shall be accomplished in the same manner as the connected pipe. Extreme care shall be used in backfilling wellpoint holes to prevent voids and settlement. If necessary, the holes should be plugged with a concrete slurry, such plugging to be at the expense of the Contractor.

4. Compaction: Shall be by hand or by mechanical tampers. Care shall be taken that the pipe is not struck by the tamper. Compaction by flooding may be allowed by written authorization of the Engineer although this will not release the Contractor of the responsibility to meet the required density.
5. The Contractor is to compact the backfill in such a manner to prevent settlement. Although the requirements of 3.03 may be met, nonsettlement is not assured and Contractor is not relieved of his responsibility by such compliance.
6. Pipe shall be laid and backfilled so that pipe deflection does not exceed five (5) percent.
7. All pipe shall laid to within 5% of the specified slope. Structure inverts shall be within 0.10 foot of the vertical elevation shown on the drawings.
8. Corrugated plastic pipe shall receive a minimum of 24" of cover. In the event that 24" of cover cannot be provided, the Contractor shall notify the Engineer immediately.
9. The Contractor shall perform soil density tests as described in Section 310000.
10. All testing shall be paid for by the Contractor by a qualified testing laboratory of his choosing.
11. Open trenches shall be backfilled to surrounding grade at the close of each work day.

### 3.5 CULVERT REMOVAL AND REPLACEMENT:

- 3.5.1 Culverts, catch basins and other drainage structures that are removed or damaged during construction shall be replaced with materials and structures equal and similar to those removed or damaged. Manhole covers and gratings shall be set at the original elevations unless otherwise directed.
- 3.5.2 The Contractor shall take precautions against the entry of excavated and other loose material resulting from his operations from entering catch basins, culverts and other drainage structures in the vicinity of his operations. He shall maintain the cleanliness of these drainage structures in a condition equal to that prior to the commencement of his operations during the construction. The Contractor shall be responsible for all damage to persons, roads, buildings, vehicles and other property resulting from the failure of the Contractor to maintain these drainage structures.

3.6 SYSTEM TESTING:

- 3.6.1. The Contractor shall furnish all necessary equipment and labor to perform testing of all gravity sewers as set forth in the following and shall conduct such tests in the presence of the Engineer and other authorized agencies, with five days advance written notice provided.
- 3.6.2 The installed sewers shall be visually inspected by "lamping" between manholes, inlets, lampholes or other structures in order to ascertain that they are clear and to correct alignment. The concentricity of the lamp image received shall be such that the diameter of said image shall have no vertical or horizontal reduction from that of the pipe inside diameter.
- 3.6.3 Should any of the tests fail, necessary repairs shall be accomplished by the Contractor and the test repeated until within the established limits. The Contractor shall furnish the necessary labor, and all other items required to conduct the required testing, and shall perform the necessary system repairs required to comply with the specified test.

3.7 RESTORATION OF DAMAGED SURFACES, STRUCTURES AND PROPERTY: Where pavement, trees, shrubbery, fences or other property and surface structures not designated as pay items, have been damaged, removed or disturbed by the Contractor, whether deliberately or through failure to carry out the requirements of the contract documents, state laws, municipal ordinances or the specific direction of the Engineer, or through failure to employ usual and reasonable safeguards, such property and surface structures shall be replaced and repaired at the expense of the Contractor to a condition equal to that before work began within a time frame approved by the Engineer at no cost to the Owner.

3.8 CLEANUP: The Contractor shall maintain the site of the work in a neat condition. The Contractor shall remove all excess materials, excess excavated materials and all debris resulting from his operations within a time frame approved by the Engineer.

END OF SECTION



## SECTION 33 71 73

### ELECTRICAL UTILITY SERVICES

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Section includes arrangement with Utility Company for electric service outages; payment of Utility Company charges for Utility required changes to service.

##### 1.02 SYSTEM DESCRIPTION

- A. Utility Company: Florida Public Utilities. Contact Curtis Boatwright.
- B. System Characteristics: 208/120 volts, single phase, three- wire, 60 Hertz.
- C. Service Entrance: Underground from pad mount transformer and exposed on building exterior. Modify conduits at service entrance equipment connection.
- D. Metering: Metering is existing current transformer type in secondary compartment of transformer.

##### 1.03 SUBMITTALS

- A. Section 01330 - Submittal Procedures.

##### 1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with Utility Company written requirements.
- B. Maintain one copy of each document on site.

##### 1.05 FIELD MEASUREMENTS

- A. Verify field measurements are as indicated on Utility drawings.

##### 1.06 COORDINATION

- A. Coordinate with utility company, the relocation of any overhead or underground lines interfering with the construction.

#### PART 2 PRODUCTS

##### 2.01 UTILITY METERS

- A. Meters will be furnished by Utility Company.

### PART 3 EXECUTION

#### 3.01 EXAMINATION

- A. Section 01300 - Administrative Requirements: Coordination and project conditions.
- B. Verify that service equipment is ready to be connected and energized.

#### 3.02 INSTALLATION

- A. Modify service entrance conduits at connection to building service entrance equipment. Connect service entrance conductors to service entrance equipment.
- B. Coordinate with Utility to minimize power outages in performance of work.

END OF SECTION