

PROJECT MANUAL
INCLUDING CONSTRUCTION SPECIFICATIONS

for

BP-S00193, SOUTH EMPLOYEE LOT

CONTRACT DOCUMENTS
Volume 4 of 4

ORLANDO INTERNATIONAL AIRPORT
10403 Jeff Fuqua Boulevard North
Orlando, Florida 32827



GREATER ORLANDO AVIATION AUTHORITY

Documents Prepared and Submitted by:

HNTB Corporation
11346 Terminal C Service Rd., Orlando, Florida 32827
Phone: (407) 825-1592/Fax:

DIVISION 0 – TABLE OF CONTENTS

NON-FEDERAL VERSION

<u>DIV 0</u>	<u>PROCUREMENT AND CONTRACTING REQUIREMENTS</u>	<u>EDITION</u>
00 11 13	Advertisement for Bids-nf	October 2020
00 21 13	Instructions to Bidders-nf	October 2020
00 31 11	Project Directory	October 2020
00 41 13	Bid Form-nf Stipulated Sum (Single-Prime Contract)	October 2020
00 41 13.13	Exhibit A - Schedule of MWBE Subcontractor Participation of Total Bid Price	October 2020
00 41 13.14	Exhibit B - Schedule of LDB/VBE Subcontractor Participation of Total Bid Price	October 2020
00 41 13.15	Exhibit C - Schedule of DBE Subcontractor Participation of Total Bid Price	October 2020
00 43 13	Bid Security Form	October 2020
00 45 13	Bidder's Qualifications	October 2020
00 52 13	Contract Form-nf Stipulated Sum (Single-Prime Contract)	October 2020
00 61 13	Performance and Payment Bond Cover Sheet	October 2020
00 61 13.13	Performance Bond Form	October 2020
00 61 13.16	Payment Bond Form	October 2020
00 61 13.19	Performance and Payment Bond Certification Form	October 2020
00 62 16	Certificate of Insurance Form	October 2020
00 62 76.19	Partial Release for Reduction of Retainage	October 2020
00 62 93	Construction Administration Forms	October 2020
00 65 19.29	Final Release Form	October 2020
00 65 19.33	Subcontractor Final Release Form	October 2020
00 72 13	General Conditions Stipulated Sum (Single-Prime Contract)	May 2021
00 73 00	Supplementary Conditions of the Contract for Constructions	October 2020
00 73 19.13	Hazardous Materials	October 2020
00 73 83.13	Dispute Review Board	May 2021
00 73 83.19	Dispute Review Board Three Party Agreement	May 2021
00 73 93	Special Conditions Regarding Construction at Airport Facilities	October 2020
00 73 93.01	Security and Badging at Airports	October 2020
00 73 93.02	FIS/CBP Access Procedures at OIA	October 2020
00 73 93 03	Special Project Procedures for Sensitive Security Information	October 2021

TABLE OF CONTENTS

<u>DIV 01</u>	<u>GENERAL REQUIREMENTS</u>	<u>EDITION</u>
01 11 00	Summary of Work	February 2022
01 25 00	Substitution Procedures	February 2022
01 29 73	Schedule of Values	February 2022
01 31 13	Project Coordination	February 2022
01 31 14.13	System Interruptions-Utility Outage Notification Procedures	February 2022
01 31 19	Project Meetings	February 2022
01 32 13	Scheduling of Work	February 2022
01 32 33	Photographic Documentation	February 2022
01 33 23	Shop Drawings, Product Data and Samples	February 2022
01 42 00	References	February 2022
01 45 00	Quality Control	February 2022
01 50 00	Temporary Facilities and Controls	February 2022
01 55 30	Requirements for use of Canal Road	February 2022
01 60 00	Product Requirements	February 2022
01 71 23	Field Engineering	February 2022
01 73 29	Cutting and Patching	February 2022
01 74 23	Final Cleaning	February 2022
01 78 00	Closeout Submittals	February 2022
<u>DIV 02</u>	<u>CONSTRUCTION</u>	<u>EDITION</u>
02 40 00	Demolition and Maintenance of Service During Construction	February 2022
02 41 00	Pipeline Removal and Abandonment	February 2022
02 42 00	Pavement Removal and Replacement	February 2022
<u>DIV 03</u>	<u>CONCRETE</u>	<u>EDITION</u>
03 35 00	Concrete Finishes	February 2022
03 40 00	Precast Concrete Structures	February 2022
03 60 00	Grout	February 2022
<u>DIV 09</u>	<u>FINISHES</u>	<u>EDITION</u>
09 90 00	Painting	February 2022
<u>DIV 10</u>	<u>SITE IMPROVEMENTS</u>	<u>EDITION</u>
10 73 00	Extruded Aluminum Walkway Covers	February 2022

ORLANDO INTERNATIONAL AIRPORT
BP-S00193, EMPLOYEE PARKING LOT

<u>DIV 13</u>	<u>SITE IMPROVEMENTS</u>	<u>EDITION</u>
13 34 23.16	Fabricated Control Booths	February 2022
<u>DIV 22</u>	<u>EQUIPMENT</u>	<u>EDITION</u>
22 05 53	Piping, Valves, and Equipment Identification System	February 2022
<u>DIV 26</u>	<u>ELECTRICAL</u>	<u>EDITION</u>
26 05 12	OUC Underground Electric	February 2022
26 05 19	Electrical Power Conductors and Cables	February 2022
26 05 26	Grounding and Bonding for Electrical Systems	February 2022
26 05 43	Underground Ducts and Raceway	February 2022
26 24 16	Panelboards	February 2022
26 41 13	Lightning Protection for Structures	February 2022
26 56 00	Exterior Lighting	February 2022
26 56 13	Lighting Poles	February 2022
<u>DIV 27</u>	<u>COMMUNICATIONS</u>	<u>EDITION</u>
27 05 00	Common Work Elements for Communications	February 2022
27 10 00	Premise Distribution	February 2022
<u>DIV 28</u>	<u>ELECTRONIC SAFETY AND SECURITY</u>	
28 23 00	Video Surveillance System	
<u>DIV 31</u>	<u>SITWORK</u>	<u>EDITION</u>
31 00 00	Earthwork	February 2022
31 11 00	Clearing, Grubbing, and Stripping	February 2022
31 22 19	Finish Grading	February 2022
31 23 19	Dewatering	February 2022

ORLANDO INTERNATIONAL AIRPORT
BP-S00193, EMPLOYEE PARKING LOT

<u>DIV 32</u>	<u>SITE IMPROVEMENTS</u>	<u>EDITION</u>
32 16 00	Concrete Curbs and Gutters	February 2022
32 31 13	Chain-Link Fence	February 2022
32 92 23	Solid Sodding	February 2022
<u>DIV 33</u>	<u>UTILITIES</u>	<u>EDITION</u>
33 01 12	Leakage Testing of Water Retaining Structures	February 2022
33 01 30	Leakage and Infiltration Testing	February 2022
33 01 30.42	Cleaning Sanitary Sewer Systems	February 2022
33 05 05	Utility Piping, Fittings, Valves and Accessories	February 2022
33 05 05.31	Pressure Testing of Piping	February 2022
33 05 05.41	Low Pressure Air Testing of Installed Sewer Pipe	February 2022
33 05 19	Pressure Piping Tied Joint Restraint System	February 2022
33 11 00	Water Utility Distribution Piping	February 2022
33 13 00	Disinfection of Water Utility Distribution	February 2022
33 32 16	Packaged Wastewater Pumping Station	February 2022
33 32 33	Collection System Bypass	February 2022
33 33 00	Gravity Sewers	February 2022
33 34 00	Pressurized Piping Systems	February 2022
<u>DIV 34</u>	<u>FDOT STANDARDS</u>	<u>EDITION</u>
34 70 00	FDOT Standards	February 2022

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

SECTION 26 05 19 – BUILDING WIRE AND CABLE

PART 1- GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Contractual Conditions and Division 01 Specification sections apply to this section.

1.2 SUMMARY

- A. This section includes the requirements for provision and installation of Building Wire and Cable.

1.3 DESCRIPTION

- A. Provide all equipment, labor, material, accessories, and mounting hardware to properly install all conductors and cables rated 600 volts and less for a complete and operating system for the following:
 - 1. Building wire and cable.
 - 2. Wiring connectors and connections.
- B. No aluminum conductors shall be permitted.
- C. All sizes shall be given in American Wire Gauge (AWG) or in thousand circular mils (MCM/KCMIL).

1.4 SUBMITTALS

- A. Product Data: Submit catalog cut sheet showing, type and UL listing of each type of conductor, connector and termination.

1.5 QUALIFICATIONS

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

1.6 REFERENCES AND REGULATORY REQUIREMENTS

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

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

1.7 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Conductor sizes are based on copper.
- C. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.
- D. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required. Record actual routing on red lined as-builts.
- E. Conductors with different voltages (i.e. 120 volt and 277 volt) shall not be combined in the same conduit without prior written approval from OAR and Engineer. If conductors of different voltages (120 and 480/277) are in the same duct they shall be identified by separate colors.
- F. Conductors for each branch of power (Normal, Life safety, Critical, Security, and Equipment) shall be installed in its own dedicated raceway system.

1.8 COORDINATION

- A. Determine required separation between cable and other work.
- B. Coordinate cable routing to avoid interference with other work disciplines.

PART 2 - PRODUCTS

2.1 BUILDING WIRE AND CABLE

- A. Description: Single conductor insulated wire.
- B. Conductor: Copper.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation: ANSI/NFPA 70, Type THHN/THWN and XHHW.
- E. Cable supports shall be O Z/Gedney Type "S" or approved substitution.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

PART 3 - EXECUTION

3.1 GENERAL

- A. Install products in accordance with manufacturer's instructions.
- B. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- C. Before installing raceways and pulling wire to any mechanical equipment, verify electrical characteristics with final submittal on equipment to assure proper number and AWG of conductors. (As for multiple speed motors, different motor starter arrangements, etc.).
- D. Conductors #12 AWG shall be 600 volt type THHN/THWN, solid unless specifically noted otherwise, rated 90 degrees C. dry.
- E. Use conductor not smaller than 12 AWG for power and lighting circuits.
- F. Provide dedicated neutral conductor for each branch phase conductor for 120V and 277V circuits (power and lighting). Multi-pole breakers to comply with NEC 210.4 are not permitted.
- G. Use 10 AWG conductors minimum for 20 ampere, 120 volt branch circuits longer than 75 feet (23 m). See General Notes on drawings for additional requirements.
- H. Use 10 AWG conductors minimum for 20 ampere, 277 volt branch circuits longer than 200 feet (61 m). See General Notes on drawings for additional requirements.
- I. All conductors shall be installed in raceway.
- J. Conductor sizes indicated on circuit homeruns or in schedules shall be installed over the entire length of the circuit unless noted otherwise on the drawings or in these specifications.
- K. Coordinate all wire sizes with lug sizes on equipment, devices, etc. Provide/install lugs as required to match wire size.
- L. Where oversized conductors are called for due to voltage drop, etc., provide/install lugs as required to match conductors, or provide/install splice box, and splice to reduce conductor size to match lug size.

3.2 EXAMINATION

- A. Verify that interior of building has been protected from weather.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- B. Verify that mechanical work likely to damage wire has been completed.

3.3 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

3.4 WIRING METHODS

- A. Use only building wire, Type THHN/THWN insulation, in raceway unless noted otherwise.
- B. Wiring in vicinity of heat producing equipment: Use only XHHW insulation, in raceway.
- C. Conductors installed within fluorescent fixture channels shall be Type THHN or XHHW, rated 90 degrees C dry. Conductors for all other light fixtures shall have temperature ratings as required to meet the UL listing of the fixture; however, in no case shall the temperature rating be less than 90 degrees Centigrade. Remove incorrect insulation types in new work.

3.5 INTERFACE WITH OTHER PRODUCTS

- A. Identify wire and cable under provisions of Section 26 05 53 Identification for Electrical Systems.
- B. Identify each conductor with its circuit number or other designation indicated on Drawings.
- C. Identify neutrals with its associated circuit number(s) per NEC Article 210.4(D).

3.6 FIELD QUALITY CONTROL

- A. Perform field inspection and testing under provisions of the General Requirements of the Contract Documents and Section 26 08 13 Tests and Performance Verification.
- B. Inspect wire for physical damage and proper connection.
- C. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.
- D. Verify continuity of each branch circuit conductor.
- E. Submit "Conductor Insulation Resistance Test" form as required in Section 26 08 13.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

3.7 VERTICAL RISERS

- A. Provide vertical cable riser supports per Article 300-19 in NFPA 70. These shall be located in accessible pullboxes of adequate size. Provide for adequate structural connection of cable supports to pullbox, which will transfer cable weight to building.

3.8 PULLING

- A. No wire shall be pulled until the conduit system is complete from pull point to pull point and major equipment terminating conduits have been fixed in position.
- B. Mechanical pulling devices shall not be used on conductors sized #8 and smaller. Pulling means which might damage the raceway shall not be used.
- C. Use only powdered soapstone or other pulling lubricant acceptable to the Designer/OAR. Compound or lubricant shall not cause the conductor or insulation to deteriorate.
- D. All conductors to be installed in a common raceway shall be pulled together. The manufacturer's recommended pulling tensions shall not be exceeded.
- E. Bending radius of insulated wire or cable shall not be less than the minimum recommended by the manufacturer.
- F. Where coaxial type conductors are installed, special requirements shall apply as outlined under that specific system detail specifications.
- G. Where control or signal circuits with a lower insulation rating enter an enclosure with conductors having a 600 volt or higher insulation rating, a separate wire way will be installed or proper clearance distance will be maintained per NEC.
- H. All conductors shall be pulled in conduits by industry approved cable pulling "tuggers" equipment. The use of construction equipment such as fork lifts, tractors and other vehicles will not be allowed. All conductors will be routed and protected by using the proper pulleys and sheaves.

3.9 CONTROL AND SIGNAL CIRCUITS

- A. For control and signal circuits above 50 VAC, conductors shall be #14 AWG minimum size, Type XHHW or THHN/THWN as permitted by NFPA 70, within voltage drop limits, increased to #12 AWG as necessary for proper operation.
- B. For control and signal circuits 50 VAC and below, conductors, at the Contractor's option, may be #16 AWG, 300 volt rated, PVC insulated, except where specifically noted otherwise in the contract documents.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- C. Conductor insulation for fire alarm systems shall be as approved by Code Inspection Authority only. Wire approvals by the Designer/OAR shall not supersede this final approval for conditions of this specific project.
- D. Install circuit conductors in conduit.
- E. Circuit conductors #10AWG and larger to be stranded.

3.10 COLOR CODING

- A. All power feeders and branch circuits No. 6 and smaller shall be wired with color-coded wire with the same color used for a system throughout the building. Power feeders above No. 6 shall either be fully color-coded or shall have black insulation and be similarly color-coded with tape in all junction boxes and panels. Tape shall completely cover the full length of conductor insulation within the box or panel.
- B. Unless otherwise approved or required by DESIGNER to match existing, color-code shall be as follows: Neutrals to be white for 120/208V system, natural grey for 277/480V system; ground wire green, bare or green, insulated ground conductor green with yellow tracer. 120/208V, Phase A - black; Phase B - red; Phase C - blue. 480/277V, Phase A brown; Phase B - orange; Phase C - yellow. All switch legs, other voltage system wiring, control and interlock wiring shall be color-coded other than those above.

3.11 TAPS/SPLICES/CONNECTORS/TERMINATIONS

- A. Taps and splices are not acceptable unless specifically noted otherwise on drawings or special written approval is granted by Designer/OAR. (See 3.1K) Submit locations, sizes, etc., where taps will be necessary to coordinate with lug sizes/quantities for review and approval prior to installation.
- B. Clean conductor surfaces before installing lugs and connectors.
- C. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- D. Power and lighting conductors shall be continuous and unspliced where located within conduit. Splices shall occur within troughs, wireways, outlet boxes, or equipment enclosures where sufficient additional room is provided for all splices. No splices shall be made in in-ground pull boxes (without special written approval of OAR).
- E. Splices in lighting and power outlet boxes, wireway, and troughs shall be kept to a minimum, pull conductors through to equipment, terminal cabinets, and devices.
- F. No splices shall be made in junction box, and outlet boxes (wire No. 8 and larger) without written approval of OAR.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- G. No splices shall be made in communications outlet boxes, pull boxes or wireways (i.e., fire alarm, computer, telephone, intercom, sound system, etc.) without written approval of OAR. Pull cables through to equipment cabinets, terminal cabinets and devices.
- H. No splices shall be made in circuits of #8 AWG conductors or larger of 1000 feet or less without written approval of the OAR.
- I. Allow adequate conductor lengths in all junction boxes, pull boxes and terminal cabinets. All termination of conductors in which conductor is in tension will be rejected and shall be replaced with conductors of adequate length. This requirement shall include the providing by the Contractor of sleeve type vertical cable supports in vertical raceway installations provided in pullboxes at proper vertical spacings.
- J. A calibrated torque wrench shall be used for all bolt tightening. A torque mark should be used after torqueing is performed. Torque mark should consist of a permanent mark over the mechanical lug, bolt, nut, etc.
- K. Interior Locations:
 - 1. All (non-electronic systems) copper taps and splices in No. 8 or smaller shall be fastened together by means of "Screw-on spring type (wire nut)" connectors. All "Push-in" or "Stab-in" type connectors are prohibited. All taps and splices in wire larger than No. 8 shall be made with compression type connectors approved by OAR and taped to provide insulation equal to wire.

END OF SECTION 26 05 19

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

SECTION 26 05 26 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Contractual Conditions and Division 01 Specification sections apply to this section.

1.2 SUMMARY

- A. This section includes the requirements for provision and installation of grounding and bonding.

1.3 DESCRIPTION

- A. Provide all labor, materials, and equipment necessary to properly install a grounding system conductor in all new branch wiring and feeder installations that shall be in full compliance with all applicable Codes as approved by the authorities having jurisdiction. The secondary distribution system shall include a grounding conductor in all raceways in addition to the return path of the metallic conduit.
- B. In general, all electrical equipment (metallic conduit, motor frames, panelboards, etc.) shall be bonded together with a green insulated or bare copper system grounding conductor in accordance with specific rules of Article 250 of the N.E.C. and State codes. Bonding conductor through the raceway system shall be continuous from main switch ground bus to panel ground bar of each panelboard, and from panel grounding bar of each panelboard to branch circuit equipment and devices.
- C. All raceways shall have an insulated copper system ground conductor throughout the entire length of circuit installed with-in conduit in strict accordance with NEC. Grounding conductor shall be included in total conduit fill determining conduit sizes, even though not included or shown on drawings. Grounding conductors run with feeders in PVC conduit outside of building(s) shall be bare only.
- D. Section Includes
 - 1. Grounding electrodes and conductors.
 - 2. Equipment grounding conductors.
 - 3. Bonding.
 - 4. Counterpoise System
 - 5. Ground Ring.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

1.4 SUBMITTALS

- A. Submit catalog cut sheet showing brand and selection for all conductors, test wells, components, etc., as specified herein showing that all materials are UL listed and labeled as applicable and manufactured in the United States.
- B. Product data shall prove compliance with Contract Documents, National Electric Code, Underwriters Laboratories, manufacturer's specifications, manufacturer's written installation data and compliance with all performance criteria.
- C. Include instructions for storage, handling, protection, examination, preparation, operation and installation of product.
- D. Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements.
- E. Show all dimensions, colors, configurations, covers and applicable labeling/stamping.
- F. Record actual locations of grounding electrodes on red lined as-built documents.
- G. Submit test results of each ground rod. See Section 26 08 13.

1.5 REFERENCES AND REGULATORY REQUIREMENTS

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

PART 2 - PRODUCTS

2.1 ROD ELECTRODE

- A. Material: Copper-clad steel.
- B. Diameter: 5/8 inch.
- C. Length: 30 feet minimum. Increase lengths as required to achieve specified resistance.

2.2 MECHANICAL CONNECTORS

- A. All grounding connectors shall be in accordance with UL 467 and UL listed for use with rods, conductors, reinforcing bars, etc., as appropriate.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- B. Connectors and devices used in the grounding systems shall be fabricated of copper or bronze materials, and properly applied for their intended use. Specified items of designated manufacturers indicate required criteria and equal products may be provided if approved. All connectors and devices shall be compatible with the surfaces being bonded and shall not cause galvanic corrosion by dissimilar metals. Materials in items not listed herein shall be of equal quality to the following specified items:
 - 1. Lugs: substantial construction, of cast copper or cast bronze, with "ground" (micro-flat) surfaces equal to Burndy QQA-B Series, two hole, T&B, or approved substitution. Light weight and "competitive" devices shall be rejected.
 - 2. Grounding and Bonding Bushings: Malleable iron, Thomas and Betts (T&B), or approved substitution.
 - 3. Piping Clamps: Burndy "GAR-TC series" with two hole compression lug under U-Bolt nut, or T&B, or approved substitution.
 - 4. Grounding Screw and Pigtail: Raco No. 983 or approved substitution.
 - 5. Fastening hardware: Grade 5 silicone bronze with beveled washers. Copperplate is not acceptable

- C. Mechanical lugs or wire terminals shall be used to bond ground wires together or to junction boxes and panel cabinets and shall be manufactured by Anderson, Buchanan, Thomas and Betts Co., or Burndy.

2.3 WIRE

- A. Material: Stranded copper.
- B. Size: Size to meet NFPA 70 requirements as a minimum, increase size if called for on drawings, in these specifications, or as required for voltage drop.
- C. Insulated THWN (or bare as noted elsewhere).

2.4 GROUNDING WELL COMPONENTS

- A. Grass Non-Traffic Areas:
 - 1. Well: Minimum 12 inch long by 12 inch wide by 18 inches deep with open.
 - 2. Well Cover: High density plastic, composolite, or cast iron with legend "GROUND" embossed on cover.
 - 3. Material: Structural Plastic, composolite, or concrete.
 - 4. Manufacturer: Brooks Products 70 Series or equal by Quazite or approved substitution.
 - 5. Increase depth, diameter or size as required to provide proper access at installed location.

- B. Paving and Low Traffic Areas:

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

1. Well: Minimum 12 inch long by 12 inch wide by 18 inches deep with open bottom.
2. Well Cover: Traffic rated for use with "GROUND" embossed on cover.
3. Material: Composolite.
4. Manufacturer: Quazite or approved substitution.
5. Increase depth, diameter or size as required to provide proper access at installed location.

2.5 GROUNDING BARS/GROUND BUS (INCLUDING 'SYSTEMS' GROUND BUS/BARS AND GROUND BUS BARS)

- A. Ground bars shall be copper of the size and description as shown on the drawings. If not sized on drawings, bus bar shall be minimum 1/4" x 2" bus grade copper, spaced from wall on insulating 2" polyester molded insulator standoff/supports, and be 12" or greater minimum overall length, allowing 2" length per lug connected thereto. Increase overall length as required to facilitate all lugs required while maintaining 2" spacing. Size of bus bar used in main electrical room shall be similar except minimum of 4" high and 24" long.
- B. Provide bolt tapping lug with two hex head mounting bolts for each terminating ground conductor, sized to match conductors. Mount on bus bar at 2 inches on center spacing. Lugs to be manufactured by Burndy, T&B or approved substitution.
- C. Bus bar shall have rows of holes in accordance with NEMA Standards for specified lugs.
- D. Standoff supports to be 2" polyester as manufactured by Glastic #2015-4C or approved substitution.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install products in accordance with manufacturer's instructions.
- B. Install grounding electrodes conductor, bonding conductors, ground rods, etc. with all required accessories.
- C. Grounding shall meet (or exceed as required to meet these specifications) all the requirements of the N.E.C., the NFPA, and applicable standards of IEEE.
- D. Where there is a conflict between these specifications and the above applicable codes or standards, or between this section and other specifications sections then the most stringent or excessive requirement shall govern. Where there is an omission of a code/standard requirement in these specifications then the code/standard requirements shall be complied with.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- E. Requirement in these specifications to comply with a specific code/standard article, etc. is not to be construed as deleting of requirements of other applicable codes/standards and their articles, etc.
- F. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.2 GROUNDING ELECTRODES

- A. All connections shall be exothermic welded unless otherwise noted herein. All connections above grade and in accessible locations may be by exothermic welding or by brasing or clamping with devices UL listed as suitable for use except in locations where exothermic welding is specifically specified in these specifications or called for on drawings.
- B. Each rod shall be die stamped with identification of manufacturer and rod length.
- C. Install rod electrodes at locations indicated and/or as called for in these specifications.
- D. Ground Resistance:
 - 1. Main Electrical Service (to each building and Site) and Generator Locations:
 - a) Grounding resistance measured at each main service electrode system and at each generator electrode system shall not exceed 5 ohms.
 - 2. Lightning Protection Ground Locations:
 - a) Lightning Protection system ground locations shall not exceed 5 ohms measured at ground electrode.
 - 3. Site Distribution Counterpoise Ground Locations:
 - a) Counterpoise system ground locations shall not exceed 25 ohms measured at ground electrode.
 - 4. Other Locations:
 - a) Resistance to ground of all non-current carrying metal parts shall not exceed 25 ohms measured at motors, panels, busses, cabinets, equipment racks, light poles, transformers, and other equipment.
 - 5. Resistance called for above shall be maximum resistance of each ground electrode prior to connection to grounding electrode conductor. Where ground electrode system being measured consists of two (2) or more ground rod electrodes at each location, then the resistance specified above shall be the maximum resistance with

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

two (2) or more rods connected together but not connected to the grounding electrode conductor.

- E. Install additional rod electrodes as required to achieve specified resistance to ground (specified ground resistance is for each ground rod location prior to connection to ground electrode conductor).
- F. Provide grounding well with cover at each rod location, with the only exception being a site distribution counterpoise ground rod. Install grounding well top flush with finished grade.
- G. Install ground rods not less than 1 foot below grade level and not less than 2 feet from structure foundation.

3.3 GROUND RESISTANCE AT LOCATION OTHER THAN LOCATION OF GROUNDING ELECTRODES.

- A. Resistance to ground of all non-current carrying metal parts shall not exceed 25 ohms measured at motors, panels, busses, cabinets, equipment racks, light poles, transformers, and other equipment.

3.4 GROUNDING ELECTRODE CONDUCTOR

- A. Conductor shall be sized to meet (or exceed requirements of Contract Documents) the requirements of NEC 250.66.

3.5 EQUIPMENT GROUNDING CONDUCTOR

- A. Grounding conductors shall be provided with every circuit to meet (or exceed requirements of Contract Documents) the requirements of NEC 250.122.
- B. At every voltage level, new portions of the electrical power distribution system shall be grounded with a dedicated copper conductor which extends from termination back to power source in supply panelboard.
- C. Provide separate, insulated (bare if with feeder in PVC conduit) conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
- D. Except as otherwise indicated, each feeder raceway on the load side of the service entrance shall contain a ground conductor sized as indicated and where not shown shall be sized to meet (or exceed requirements of Contract Documents) the requirements of NEC 250.122. Conductor shall be connected to the equipment grounding bus in switchboards and panelboards, to the Grounding Bus in all motor control centers, and as specified, to lighting fixtures, motors and other types of equipment and outlets. The ground shall be in addition to the metallic raceway and shall be connected, using a lug

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

device located within each item enclosure at the point of electric power connections to permit convenient inspection.

- E. Provide green insulated ground wire for all grounding type receptacles and for equipment of all voltages. In addition to grounding strap connection to metallic outlet boxes, a supplemental grounding wire and screw equal to Raco No. 983 shall be provided to connect receptacle ground terminal to the box.
- F. All plugstrips and metallic surface raceway shall contain a green insulation ground conductor from supply panel ground bus connected to grounding screw on each receptacle in strip and to strip channel. Conductor shall be continuous.
- G. Where integral grounding conductor is specified elsewhere in bus duct construction, provide equivalent capacity conductor from supply switchboard or panelboard grounding bus to the bus duct grounding conductor. Bond integral conductor to bus duct enclosure at each tap and each termination.
- H. All motors, all heating coil assemblies, and all building equipment requiring flexible connections shall have a green grounding conductor properly connected to the frames and extending continuously inside conduit with circuit conductors to the supply source bus with approved connectors regardless of conduit size or type. This shall include "Equipment By Owner" to which an electric conduit is provided under this Division.

3.6 MAIN ELECTRICAL SERVICE

- A. Complete installation shall meet or exceed the requirements of the NEC 250.
- B. Artificial electrodes shall be provided for the main service in sufficient number and configuration to secure resistance specified.
- C. Provide and bond to all of the following:
 - 1. Ground rods.
 - 2. Metal water pipe.
 - 3. Building metal frame, structural steel or reinforced structural concrete.
 - 4. Encased Electrodes.
 - 5. Ground ring.
 - 6. Site distribution counterpoise ground system.
 - 7. Lightning protection system.
- D. A main ground, bare copper conductor, sized per NEC Table 250.66, but in no case less than #2/0, shall be run in conduit from the main switchgear of each building to the building steel in respective building. This ground conductor shall also be run individually from the main switchgear and be bonded to the main water service ahead of any union in pipe and must be metal pipe of length and location as acceptable by authorities having jurisdiction. Provide properly sized bonding shunt around water meter and/or

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

dielectric unions in the water pipe. Also required is the same size ground wire to ground rod electrode as called for below:

1. Three 30 ft. ground rods in a delta configuration at no less than 30 ft. spacing driven to a minimum depth of 30 feet, one foot below grade.
2. Bond ground rod electrodes together with a bare copper ground conductor that matches size required by NEC Table 250.66, but in no case less than #2/0.
3. Provide additional rod electrodes as required to achieve specified ground resistance.

E. Ground/bond neutral per NEC 250.

F. A main ground, bare copper conductor, sized per applicable Table in NEC 250, but in no case less than #2/0, shall be run in conduit from the main switchgear of each building to a concrete encased electrode per NEC 250.52(3).

1. For New Buildings: Provide and install and bond to concrete encased electrode in compliance with the NEC.
2. For Existing Buildings: Bond to existing concrete encased electrode when available.

G. Bond grounding electrodes to site counterpoise grounding system and lightning protection system where provided.

H. Provide and install ground bus bar on wall near main service disconnect/switchboard. Connect to ground bar in disconnect/switchboard bonded to switchboard/disconnect enclosure/neutral with copper grounding conductor sized per NEC Table 250.66.

3.7 TRANSFORMER GROUNDING

A. Ground all transformers and enclosures of 120/208V and 277/480V "separately derived systems" as specified herein.

1. Ground per NEC 250 and these specifications.
2. Bond neutral to transformer frame/enclosure and the equipment grounding conductors of the derived system with copper ground conductor sized per NEC Table 250.66.
3. Connect transformer neutral/ground to grounding electrode per NEC 250.30 with grounding electrode conductor sized per NEC Table 250.66.
4. In addition to connection to grounding electrode conductor called for above, provide supplemental grounding electrode as follows:
 - a) Where grounding required per NEC 250.30 is to building steel/structure, supplement this grounding with connection to nearest available effectively grounded metal water pipe.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- b) Where grounding connection required per NEC 250.30 is to grounded metal water pipe, supplement with connection to building steel/structure in addition to any other available electrodes specified in NEC 250.50 and 250.52.
 - c) Where supplemental grounding electrodes required above is a ground rod electrode, provide two or more 30 ft. ground rod electrodes at no less than 30 ft. spacing, driven full length into the earth one foot below grade.
- 5. Where neither building steel nor water pipe grounding electrodes are available (i.e. exterior locations with no available water pipe electrode) provide two (2) ground connections: each 30 ft. ground rod electrodes at not less than 30 ft. spacing, driven full length into the earth one foot below grade.
 - 6. Where transformer is mounted to exterior of building, one (1) of the two (2) ground electrodes required shall be ground rod electrode as called for in 5. above. This ground rod electrode shall also be connected to counterpoise system.
- B. Provide additional ground electrodes as required to achieve specified ground resistance.
 - C. Where two or more ground electrodes are used at any required ground location, they shall be bonded together with a copper ground conductor, sized to meet NEC Table 250.66, but in no case less than #2/0.
 - D. Complete installation shall meet or exceed the minimum requirements of NEC 250.
 - E. Equipment ground conductors shall be provided in addition to above grounding. See 'EQUIPMENT GROUNDING CONDUCTOR', NEC 250.122.
 - F. Provide ground bus bar on wall near transformer (or in associated electrical room for exterior mounted transformers). Connect to ground lug in transformer bonded to transformer enclosure/neutral with copper ground conductor sized per NEC Table 250.66.
 - G. Multiple separately derived systems may be grounded as allowed in NEC 250-30(A)(4).
- 3.8 GENERATOR GROUNDING
- A. Separately derived systems (i.e. systems where generator neutral is not solidly interconnected to service supplied system neutral such as 4 pole switched neutral transfer switch systems).
 - 1. Ground per NEC 250.20, 250.30, 250.66 and these specifications.
 - 2. Bond neutral to transformer frame/enclosure and the equipment grounding conductors of the derived system with copper ground conductor sized per NEC Table 250.66.
 - 3. Connect generator neutral/ground to grounding electrodes per NEC 250.30 with grounding electrode conductor sized per NEC Table 250.66.
 - 4. In addition, provide supplemental grounding electrode as follows:

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- a) Where grounding required per NEC 250.30 is to building steel/structure, supplement with connection to nearest available effectively grounded metal water pipe.
 - b) Where grounding connection required per NEC 250.30 is to grounded metal water pipe, grounding with connection to other electrodes specified in NEC 250.50 and 250.52.
 - c) Where supplemental grounding electrode required above is a ground rod electrode, provide two or more 30 ft. ground rod electrodes at no less than 30 ft. spacing, driven vertical to a minimum depth of 30 ft. plus 1 foot below grade.
5. Where neither building steel nor water pipe grounding electrodes are available provide two (2) ground connections: each to two (2) or more 30 ft. ground rod electrodes at no less than 30 ft. spacing, driven vertical to a minimum depth of 30 ft. plus 1 foot below grade.
 6. Where generator is mounted to exterior of building, one (1) of the two (2) ground electrodes required shall be ground rod electrode as called for in Paragraph 3.8 A.5. This ground rod electrode shall also be connected to counterpoise system.
- B. Provide additional ground electrodes as required to achieve specified ground resistance.
 - C. Where two or more ground electrodes are used at any one required ground location, they shall be bonded together with a copper ground conductor, sized to meet NEC Table 250.66, but in no case less than #2/0.
 - D. Complete installation shall meet or exceed the minimum requirements of NEC 250.
 - E. Equipment ground conductors shall be provided in addition to above grounding. See 'EQUIPMENT GROUNDING CONDUCTOR'.
- 3.9 LIGHTNING PROTECTION SYSTEMS
- A. Ground per Section 26 41 13 – Lightning Protection for Structures, NFPA 780, and as specified herein. The most stringent requirements shall govern.
 - B. Bond lightning protection system grounds to electrical service system ground, and counterpoise system ground where provided.
- 3.10 EXTERIOR GRADE (OR FREE STANDING ABOVE GROUND) MOUNTED EQUIPMENT
- A. General:
 1. All equipment mounted exterior to building shall have their enclosures grounded directly to a grounding electrode at the equipment location in addition to the building equipment ground connection.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

2. Bond each equipment enclosure, metal rack support, mounting channels, etc. to ground electrode system at each rack with an insulated copper ground conductor sized to match the grounding electrode conductor required by NEC Table 250.66 based on equipment feeder size, but in no case shall conductor be smaller than #6 copper or larger than #2 copper. This connection is in addition to grounding electrode connections required for services.
- B. Main electrical service rack mounted equipment.
1. Ground per "MAIN ELECTRICAL SERVICE".
 2. Bond all metal parts as noted in this section.
- C. Electrical sub service rack mounted equipment.
1. Ground per "MAIN ELECTRICAL SERVICE", except do not bond neutral to ground.
 2. Bond all metal parts as noted in this section.
- D. Electrical equipment connection rack mounted equipment.
1. Bond all metal parts as noted in this section.
- E. Grounding electrodes (ground electrodes system) shall be:
1. Located at each rack location.
 2. For service equipment: Ground electrode required per "MAIN ELECTRICAL SERVICE".
 3. For equipment connection: Two or more 30 ft. ground rods at no less than 30 ft. spacing, driven vertical to a minimum depth of 30 ft. plus 1 ft. below grade. Bond ground rods together with a size to meet NEC Table 250.66, but no less than a #2 copper ground conductor. Provide additional rod electrodes as required to achieve specified ground resistance.
- F. Complete installation shall meet or exceed the minimum requirements of NEC 250 and, when applicable, NFPA 78.
- 3.11 ROOF MOUNTED EQUIPMENT
- A. Bond all roof mounted electrical equipment to lightning protection system (when provided) per NFPA 780.
- 3.12 LIGHTING FIXTURES
- A. All new and reinstalled fixtures shall be provided with green grounding conductor, solidly connected to unit. Individual fixtures grounds shall be with lug to fixture body, locate at point of electrical connection to the fixture unit.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

B. All suspended fixtures and those supplied through flexible metallic conduit shall have green ground conductor from outlet box to fixture. Cord connected fixtures shall contain a separate green ground conductor.

C. Pole Light Fixtures:

1. Metal Pole Light Fixtures:

- a) Freestanding pole mounted lighting fixtures shall each have a - Class I or Class II Materials - lightning protection main copper down conductor connected to grounding electrodes at base of pole.
- b) Conductor shall be bonded to metal pole via UL Listed ground clamp suitable for use. Locate ground lug opposite to handhole (or adjacent if visible through handhole).

2. Concrete or Non-Metallic Pole:

- a) Freestanding pole mounted lighting fixtures shall each have a Class I or Class II lightning protection main copper down conductor connected to grounding electrodes at base of pole.
- b) Conductor shall be extended from grounding electrode to top of pole and terminate at the top of pole in a Class I or Class II copper lightning protection air terminal.
- c) Each metal part of light fixture assembly, bracket, ballast cabinet, disconnect, transformer, etc. that is mounted to pole shall be bonded to down conductor.

3. Fixtures located on elevated roadway ramps: provide with a connection to lightning counterpoise grounding system.

4. Grounding electrode(s) at each pole shall be bonded to site distribution counterpoise system.

5. Grounding Electrodes:

- a) Two or more 30 ft. ground rods at no less than 30 ft. spacing shall be driven full length into the earth one foot below grade.
- b) Bond ground rod electrodes together with a Class I or Class II lightning protection main copper conductor.
- c) Provide additional rod electrodes as required to achieve specified ground resistance.
- d) Two (2) or more grounding rod electrodes shall be installed at each light pole.

6. Installation shall exceed minimum requirements of NFPA 780.

3.13 PULLBOX, MANHOLE, HANDHOLE GROUNDING.

A. One 30 ft. ground rod electrode shall be driven vertically to a minimum depth of 30 ft. plus 1 ft. below grade in each manhole, handhole or pullbox (in ground).

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- B. The complete installation shall exceed the minimum requirements of the NEC.
- C. Provide additional ground rod electrodes as required to provide resistance called for herein.
- D. Where more than one ground rod electrode is required bond the two or more ground rod electrodes together with a copper ground conductor as called for under 'Counterpoise System.'
- E. Bond to counterpoise system.
- F. Bond grounding electrode to all exposed metal parts of manhole, handhole, pullbox (including metal cover) with #6 copper ground conductor. Connect to ground rod electrode with exothermic weld. Connect to metal cover with exothermic weld. Connect to other metal parts with exothermic weld or UL approved grounding clamp. Provide minimum 3 ft. slack ground cable on cover connection to facilitate removal of cover.

3.14 HAZARDOUS LOCATIONS

- A. Grounding in hazardous locations shall be done in accordance with applicable portions of Articles 500, 501, 502, 503, 511 and 514 of the National Electrical Code.

3.15 GROUND RING

- A. Provide complete underground building perimeter ground ring system, completely encircling building.
- B. Install minimum 2-1/2 feet depth into earth.
- C. Install ground rods (minimum 30 ft. long) every 150 feet section of ground ring conductor.
- D. Bond ground ring to building steel every 150 feet of building perimeter, bond to any and all electrical and piping systems that cross the ground ring system, bond to lightning protection down conductors and to any lightning or other earth grounding electrodes that may be present on the premises.
- E. Bond to building service and counterpoise ground systems.

3.16 MISCELLANEOUS GROUNDING CONNECTIONS

- A. Provide bonding to meet regulatory requirements.
- B. Required connections to building steel shall be with UL approved non-reversible crimp type ground lugs exothermically welded to bus bar that is either exothermically welded to

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

steel or bolted to steel in locations where weld will affect the structural properties of the steel.

- C. Install grounding conductors to permit shortest and most direct path from equipment to ground; install in conduit; bond to conduit at both ends when conduit is metal; have connections accessible for inspection; and made with approved solderless connectors brazed (or bolted) to the equipment ground; in NO case be a current carrying conductor; have a green jacket unless it is bare copper; be run in conduit with power and branch circuit conductors. The main grounding electrodes conductor shall be exothermically welded to ground rods, water pipe, and building steel.
- D. All surfaces to which grounding connections are made shall be thoroughly cleaned to maximum conductive condition immediately before connections are made thereto. Metal rustproofing shall be removed at grounding contact surfaces, for 0 ohms by digital Vm. Exposed bare metal at the termination point shall be painted.
- E. All ground connections that are buried or in otherwise inaccessible locations, shall be welded exothermically. The weld shall provide a connection which shall not corrode or loosen and which shall be equal or larger in size than the conductors joined together. The connection shall have the same current carrying capacity as the largest conductor.
- F. Install ground bushings on all metal conduits entering enclosures where the continuity of grounding is broken between the conduit and enclosure (i.e. metal conduit stub-up into a motor control center enclosure or at ground bus bar). Provide an appropriately sized bond jumper from the ground bushing to the respective equipment ground bus or ground bus bar.
- G. Each feeder metallic conduit shall be bonded at all discontinuities, including at switchboards and all subdistribution and branch circuit panels with conductors in accordance with Table 250.122 of NEC for parallel return with respective interior grounding conductor.
- H. Grounding provisions shall include double locknuts on all heavywall conduits.
- I. Install grounding bus in all existing panelboards of remodeled areas, for connection of new grounding conductors, connected to an approved ground point.
- J. Bond together reinforcing steel and metal accessories in pool and fountain structures and bond to electrical system per NEC.
- K. Where reinforced concrete is utilized for building grounding system, proper reinforced bonding shall be provided to secure low resistance to earth with "thermite" type devices, and #10AWG wire ties shall be provided to not less than ten (10) full length rebars which contact the connected rebar. Provide size and length of rod to meet NEC requirements.

3.17 GROUNDING BAR/GROUND BUS (INCLUDING 'SYSTEMS' GROUND BUS/BAR ON GROUND BUS/BAR) INSTALLATION

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- A. Where indicated on the drawings, provide grounding bar/ground bus (bus bar). Metal sheaths of underground cables are also to be grounded thereto at points of building entrance.
- B. Mount bolt tapping lugs with hex head bolts to bus bar at 2" o.c. spacing, one for each ground conductor.
- C. Mount bus bar to wall using 2" polyester molded insulator stand-off.
- D. Extend a #2/0 (minimum size) or larger THWN insulated copper ground conductor (if larger size is called for on drawings or required by N.E.C. for service ground, etc.) in PVC conduit to approved service ground installation or ground bus/bar in main service equipment enclosure.
- E. Extend #6 insulated copper ground wire from respective bus/bar to each 'local' ground bus/bar in each cabinet for system.
- F. 'SYSTEMS' grounding bus/bar must be connected with #2/0 insulated copper conductor to grounding electrodes system as defined in NEC "Article 800-40(b).

3.18 COUNTERPOISE SYSTEM

- A. Install counterpoise and ground over all sections of underground ductbanks, conduits, or cables outside (exterior) to building.
- B. No. 2 bare stranded copper counterpoise shall be run 6 inches above all underground duct banks, conduits and cables outside (exterior) to building.
- C. Provide one counterpoise conductor for ductbanks (or conduit groupings) 12 inches wide or less. Provide two counterpoise conductors above outside edge of ductbank (or conduit groupings) over 12 inches wide.
- D. Counterpoise shall run to building and be grounded at each building to the main building electrical service ground rod electrode (exterior to building). Counterpoise shall be bonded to ground rod at all light poles, pullboxes, manholes, handholes and at each building. Provide and install appropriate ground rod every 150 foot length of counterpoise conductor (see "Grounding Electrodes"). Counterpoise conductor shall not be run into interior of building. Route counterpoise underground around exterior perimeter of building to main service ground rod installation.

3.19 TESTING AND REPORTS

- A. Raceway Continuity: Metallic raceway system as a component of the facilities ground system shall be tested for electrical continuity. Resistance to ground throughout the system shall not exceed specified limits.
- B. Ground resistance measurements shall be made on each system utilized including:

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

1. Building structural steel.
 2. Driven grounding system.
 3. Water pipe grounding system.
 4. Other approved systems.
- C. Ground resistance measurements shall be made in normally dry weather, not less than 24 hours after rainfall, and with the ground under test isolated from other grounds and equipment. Resistances measured shall not exceed specified limits.
- D. Upon completion of testing, the testing conditions and results shall be certified by the Contractor and submitted to the Designer as called for in Section 26 08 13 - Test and Performance Verification.
- 3.20 INTERFACE WITH OTHER PRODUCTS
- A. Interface with site grounding system.
 - B. Interface with lightning protection system installed under Section 26 41 13.
- 3.21 FIELD QUALITY CONTROL
- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
 - B. Use suitable test instruments to measure resistance to ground of system. Perform testing in accordance with test instrument manufacturer's recommendations using the fall- of-potential method.

END OF SECTION 26 05 26

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

SECTION 26 05 43
UNDERGROUND DUCTS AND RACEWAY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Contractual Conditions and Division 01 Specification sections apply to this section.d

1.2 SUMMARY

- A. This section includes the requirements for provision and installation of underground ducts and raceways for electrical systems.

1.3 DESCRIPTION

- A. Provide and install all equipment, labor, material, accessories and mounting hardware for a complete and operating duct bank system including, but not limited to:
 - 1. Plastic conduit.
 - 2. Metal conduit.
 - 3. Rigid Metal.
 - 4. Duct.
 - 5. Manholes
- B. System to include PVC conduit with black mastic coated rigid galvanized sweeping elbows for all changes in direction, all encased in 3 inch red concrete envelope.
- C. Manholes are to be size and type as required for use. Manholes for primary power must comply with requirements of local utility company (OUC).

1.4 SUBMITTALS

- A. Shop Drawings: Indicate dimensions, reinforcement, size and locations of openings and accessory locations for manholes.
- B. Product Data: Provide for nonmetallic conduit and manhole accessories
- C. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

1.5 PROJECT AS-BUILT DOCUMENTS

- A. Record actual locations of exact routing of duct bank, dimension from known landmarks (Survey Points).
- B. Record actual locations of each manhole, dimension from known landmarks (Survey Points).

1.6 QUALIFICATIONS

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

1.7 REFERENCES AND REGULATORY REQUIREMENTS

- A. Furnish products listed and classified by Underwriters Laboratories, Inc. and testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.
- B. Conform to the requirements of the following:
 - 1. AASHTO - Standard Specification for Highway Bridges.
 - 2. ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated.
 - 3. ANSI/ASTM A153 - Zinc Coating (Hot Dip) on Iron and Steel Hardware.
 - 4. ANSI/ASTM A569 - Steel, Sheet and Strip, Carbon (0.15 Maximum Percent), Hot-Rolled, Commercial Quality.
 - 5. ANSI/IEEE C2 - National Electrical Safety Code.
 - 6. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
 - 7. ANSI/NFPA 70 - National Electrical Code.
 - 8. ASTM A48 - Gray Iron Castings.
 - 9. ASTM A123 - Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strips.
 - 10. NEMA TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
 - 11. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.
 - 12. NEMA TC 6 - PVC and ABS Plastic Utilities Duct for Underground Installation.
 - 13. NEMA TC 8 - Extra-Strength PVC Plastic Utilities Duct for Underground Installation.
 - 14. NEMA TC 9 - Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation.
 - 15. NEMA TC 10 - PVC and ABS Plastic Communications Duct and Fittings for Underground Installation.
 - 16. NEMA TC 14 - Filament-Wound Reinforced Thermosetting Resin Conduit and Fittings.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

1.8 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Verify routing and termination locations of duct bank prior to excavation for rough-in.
- C. Duct bank routing is shown in approximate locations unless dimensions are indicated. Route as required to complete duct system.
- D. Manhole and can plaza locations are shown in approximate locations unless dimensions are indicated. Locate as required to complete duct bank system.

PART 2 - PRODUCTS

2.1 CONDUIT

- A. Comply with Division 26 Section Conduits

2.2 Building Wire and Cable

- A. Refer to 26 05 19 Wire and Cable
- B. If wire of different voltages (120 and 277/480) are combined in the same duct. The insulation colors of the separate voltage system shall be different color in accordance with NEC 210.5

2.3 ACCESSORIES

- A. Underground Warning Tape: 4 inch wide plastic tape, detectable type, colored yellow with suitable warning legend describing buried electrical lines.

2.4 CONCRETE

- A. Concrete shall be as required by other divisions of these specifications, but in no case shall concrete be less than 3000 psi.
- B. Reinforced precast concrete, as specified in Division 03.
- C. Construction: Modular sections with tongue-and-groove joints.
- D. Reinforcing: AASHTO Classification H-20.

2.5 CAST-IN-PLACE MANHOLE ACCESSORIES

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- A. Frames and Covers: ASTM A48; Class 30B gray cast iron, 30 inch size, machine finished with flat bearing surfaces. Provide cover marked ELECTRIC to indicate utility.
- B. Cable Pulling Irons: Use galvanized rod and hardware.
- C. Cable Rack Inserts: Minimum load rating of 800 pounds (365 kg).
- D. Cable Rack Mounting: All cables in manholes shall be properly supported on cable supports a minimum of every 36". Provide new cable supports in existing manholes as required for proper support of both the new and existing cables. Supports shall be fastened to manhole wall with approved concrete anchors.
- E. Cable Racks: Shall be nonmetallic saddle type that is nonconductive and will never rust or corrode. Cable saddle rack shall be at least 32" long, 3" wide, incorporate three cable saddles that are 5" deep with a 3" throat opening and four elongated mounting holes. At least one spare hook shall be available at each cable rack position for future use.
- F. Manhole Steps: Ladder: Aluminum rung with top hook to engage manhole step. Provide one ladder for each manhole.
- G. Sump Covers: ASTM A48; Class 30B gray cast iron with hinged lift assist.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that excavation, base material installation, and compaction is completed.

3.2 PREPARATION

- A. Prepare excavation in accordance with manhole manufacturer's instructions.

3.3 UNDERGROUND INSTALLATION

- A. Use Schedule 40 thickwall nonmetallic conduit only unless local authority having jurisdiction or applicable codes/utility requirements, etc. require rigid steel conduit.
- B. Encase conduit in a concrete envelope of not less than 3" thickness on all sides and not less than 1-1/2" between conduits (where more than one conduit is installed together) for:
 - 1. All conduits installed under roads, parking lots, taxiways, and runways.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

2. All conduits installed for primary electric circuits, main feeders, and data/communications systems (i.e. Telephone, data, parking revenue, radio, flight information, air traffic control systems, security, fiber optic).

3.4 DUCT BANK INSTALLATION

- A. Install duct in accordance with manufacturer's instructions.
- B. Install duct to locate top of duct bank at depths as indicated on drawings.
- C. Install ducts with minimum slope of 4 inches per 100 feet. Slope away from building entrances.
- D. Cut duct square using saw or pipe cutter; de-burr cut ends.
- E. Insert duct to shoulder of fittings; fasten securely.
- F. Join nonmetallic duct using adhesive as recommended by manufacturer.
- G. Wipe nonmetallic duct dry and clean before joining. Apply full even coat of adhesive to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
- H. Install no more than equivalent of three 90-degree bends between pull points.
- I. Provide suitable fittings to accommodate expansion and deflection where required.
- J. Stagger duct joints vertically in concrete encasement 6 inches minimum.
- K. Use suitable separators and chairs installed not greater than 4 feet on centers.
- L. Band ducts together before placing concrete.
- M. Securely anchor duct to prevent movement during concrete placement.
- N. Place concrete under provisions of Division 03. Use mineral pigment to color concrete red.
- O. Provide minimum 3 inch concrete cover at bottom, top, and sides of duct bank.
- P. Provide suitable pull string in each empty duct except sleeves and nipples.
- Q. Swab duct. Use suitable caps to protect installed duct against entrance of dirt and moisture.
- R. Backfill trenches under provisions of Division 02.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- S. Interface installation of underground warning tape with backfilling. Install tape 6 inches below finished surface.
- T. All excavation for underground feeders shall be performed in accordance with all State of Florida standards and regulations for trench safety.
- U. Maintain a minimum of 7.5 inches center-to-center spacing between all raceways.
- V. Fill medium shall be compacted to eliminate air pockets and to assure uniform heat dissipation. Concrete shall be carefully spaded to eliminate voids. All trenches shall be free of cans, bottles, scrap lumber, trash and obstructions prior to back filling.

3.5 PRECAST MANHOLE INSTALLATION

- A. Install and seal precast sections in accordance with manufacturer's instructions.
- B. Install manholes plumb.
- C. Use precast neck and shaft sections to bring manhole cover to finished elevation.
- D. Attach cable racks to inserts after manhole installation is complete.
- E. Install drains in manholes and connect to site drainage system 4-inch pipe terminating in 1/3 cu. yd. crushed gravel bed under provisions of Division 22.
- F. Damp proof exterior surfaces, joints, and interruptions of manholes after concrete has cured 28 days, under provisions of Division 07.

3.6 COORDINATION

- A. Coordinate duct bank routing (and manhole locations) with all underground utilities and building structure. Modify location/routing shown on drawings as required to facilitate installation.

3.7 CONDUIT

- A. Install plastic conduit in concrete envelope with rigid steel sweeping elbows with largest possible factory radius for all changes in direction.
- B. Minimum bend in conduits 2" and larger shall be equal to or greater than ten (10) times the internal diameter of the conduit. Provide larger radius as necessary to achieve acceptable pulling tension or as required by cable installers.

3.8 CONDUCTORS

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- A. All duct bank and manhole systems shall completely isolate Normal Utility Power and Emergency Power Systems into two separate systems.
- B. Attach cables to nonmetallic cable racks on manhole walls in a neat and orderly way.
- C. Wire other than current carrying conductors such as control or signal wiring shall be run in a separate conduit within the duct bank. Secure wires separately at the maximum distance within the manhole from all current carrying conductors.
- D. Slack cable shall be provided in manholes by routing the cables by the longest path possible through the manholes.
- E. All cables will be secured to cable racks with nylon cable ties, no tie wire, tape or substitutes will be allowed.
- F. No metal objects such as unistrut, tie wire or angle iron that can rust and become sharp objects will be allowed in manhole.
- G. Cable splicing in manholes will not be allowed with out prior written permission from owner. Submittals for all cable splicing products will be required before permission is given.
- H. All conductors shall be pulled in conduits by industry approved cable pulling “tuggers” equipment. The use of construction equipment such as fork lifts, tractors and other vehicles will not be allowed. All conductors will be routed and protected by using the proper pulleys and sheaves.

END OF SECTION 26 05 43

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

SECTION 26 24 16 –
PANELBOARDS

PART 1- GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Contractual Conditions and Division 01 Specification sections apply to this section.

1.2 SUMMARY

- A. This section includes the requirements for provision and installation of panelboards.

1.3 DESCRIPTION

- A. Provide all labor, materials, and equipment necessary to properly and completely install panelboards as scheduled on the drawings and as required by this section.

1.4 SUBMITTALS

- A. Submit product data on each basic panelboard construction type, showing manufacturer's standard construction data including:
1. Cabinet construction/dimensions.
 2. Bus construction.
 3. UL labeling.
 4. Each overcurrent device.
- B. Shop drawings shall be submitted for each panel and clearly indicate the following information:
1. Label.
 2. Each circuit breaker amperage rating, circuit number and position/location in panel.
 3. Electrical characteristics of panel.
 4. Mains rating.
 5. Main device rating.
 6. Mounting.
 7. Dimension, width, depth, height.
 8. Bus material.
 9. Interrupting capacity of minimum rated breaker.
 10. Panel type.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

1.5 PROJECT AS-BUILT DOCUMENTS

- A. Record actual locations of Panelboards on red lined as-built documents and indicate actual branch circuit arrangement.

1.6 OPERATION AND MAINTENANCE DATA

- A. Provide spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.7 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing products specified for minimum ten years.

1.8 REFERENCES AND REGULATORY REQUIREMENTS

- A. Furnish products listed and classified by UL as suitable for purpose specified and indicated.
- B. Conform to the requirements of the following:
 - 1. ANSI/NFPA 70 - National Electrical Code.
 - 2. NECA (National Electrical Contractors Association) - "Standard of Installation."
 - 3. NEMA AB 1 - Molded Case Circuit Breakers.
 - 4. NEMA PB 1 - Panelboards.
 - 5. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
 - 6. UL 67 - Panelboards
 - 7. UL 50 - Cabinets and Boxes
 - 8. Fed. Spec. W-P-115C

1.9 FIELD MEASUREMENTS

- A. Verify that field measurements are as instructed by manufacturer.

1.10 MAINTENANCE MATERIALS

- A. Provide two keys per panelboard.

1.11 DELIVERY, STORAGE AND HANDLING

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- A. Handle panelboards and enclosures carefully to prevent damage.
- B. Store equipment indoors and protect from weather.
- C. Deliver tubs and internal assemblies sufficiently in advance of installation period as necessary to prevent delay of work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Eaton, or approved substitutions.

2.2 GENERAL

- A. Lighting and Appliance Branch Circuit Panelboards: NEMA PB1, circuit breaker type, dead front, UL 67.
- B. Panelboard Bus: Copper ratings as indicated. Provide copper ground bus in each panelboard. Provide isolated full size neutral bus where neutral is applicable. Provide non-linear load panelboards as specified on drawings. Non-linear panelboards shall have 200 percent rated neutral busbar.
- C. Short-Circuit Rating:
 - 1. Minimum short circuit interrupting capacity: 10,000 amperes rms symmetrical for 240 volt panelboards; 14,000 amperes rms symmetrical for 480 volt panelboards. Bus shall be braced for minimum capacity equal to or greater than the lowest breaker symmetrical interrupting capacity. Minimum short circuit rating shall be increased to meet the following requirements:
 - a) Individual C.B. AIC Rating shown on panel schedules indicate lowest AIC rating allowed for individual circuit breaker in panel.
 - b) Circuit breakers shall be based on a fully rated system.
 - c) Circuit breaker types are not specified. Provide breakers to comply with the required AIC specified.
- D. Enclosure:
 - 1. Enclosures shall be at least 20 inches wide made from galvanized steel. Provide minimum gutter space in accordance with the National Electrical Code. Where feeder cables supplying the mains of a panel are carried through its box to supply other electrical equipment, the box shall be sized to include the additional required wiring space. At least four interior mounting studs with adjustable nuts shall be provided.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

2. Enclosures shall be provided with blank ends.
 3. Where indicated on the drawings, branch circuit panelboards shall be column width type.
 4. Regulatory Requirements:
 - a) NEMA PB 1, Type 1, Interior dry locations.
 - b) NEMA PB 1, Type 3R, Interior damp locations.
 - c) NEMA PB 1, Type 4X stainless steel watertight, Exterior locations including those noted on drawings to be NEMA 3R.
 - d) NEMA PB 1, Type 4X stainless steel watertight, interior wet locations, and wash-down areas, regardless of that noted on drawings.
 - e) UL 50
- E. Cabinet box:
1. 6 inches (153 mm) deep; width: 20 inches (508 mm), minimum.
 2. Interior dry and damp locations shall be constructed of galvanized code gauge steel, to prevent rust.
 3. Exterior, wash-down areas, and Interior wet locations shall be constructed of type 4X stainless steel, watertight.
- F. Cabinet Front:
1. Flush or surface with concealed trim clamps, concealed hinge, and flush lock all keyed alike.
 2. Shall be door-in-door construction.
 3. Finish in manufacturer's standard baked enamel finish for interior dry locations. Interior damp location panels to be painted with rust inhibit primer epoxy paint top coat system.
 4. Exterior, wash-down areas, and Interior wet locations shall be constructed of type 4X stainless steel, watertight.
- G. Panels and breakers shall be rated for voltage and class of service to which applied.
- H. Spaces:
1. Space provisions or spaces for future breakers shall be located at the bottom of the panel and be fully bussed complete with all necessary mounting hardware less the breaker.
- 2.3 MAINS
- A. Provide main lug only (MLO) or main circuit breaker (MCB) as noted on drawings either by riser diagram or by schedule. Where conflict exists, provide MCB.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- B. Regardless of what is shown on drawings provide the following minimum requirements.
 - 1. Main circuit breaker on each panel serving building main if required by applicable codes.
 - 2. Main circuit breaker on each panel fed directly from a transformer (unless disconnect with overcurrent devices is installed in feeder between transformer and panel).
- C. Provide lugs as required for conductors being connected to panelboard lugs, circuit breakers, etc.
- D. Main circuit breaker is not to be mounted as branch breaker or subfeed breaker.

2.4 CIRCUIT BREAKERS

A. General

- 1. Molded Case Circuit Breakers: NEMA AB 1, plug-on type for 250V or less, bolt-on type for over 250V, 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 where scheduled. Do not use tandem circuit breakers.
- 2. Current Limiting Molded Case Circuit Breakers: NEMA AB 1. Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole.

B. Main Breakers:

- 1. Main breakers shall be individually mounted separate from branch breakers.
- 2. Covered by a metal plate, except for operating handle.
- 3. Connection from the load's side to the panel bus shall be bus bar. Insulated wire not permitted.

C. Branch Breakers:

- 1. Thermal-magnetic, molded case, with inverse time-current overload and instantaneous magnetic tripping, unless otherwise shown. Breakers shall be calibrated for 40 degrees C or shall be ambient compensating.
- 2. Quick-make, quick-break, with tripped indication clearly shown by breaker handle taking a position between ON and OFF.
- 3. Multi-pole breakers shall have common internal trip. No handle ties between single pole breakers are acceptable for this Project.
- 4. Single pole 15 and 20 ampere circuit breakers shall be rated for switching duty and shall be labeled as "SWD".
- 5. Rating shall be as called for under "2.2 GENERAL".
- 6. Ground Fault Circuit Interrupters (GFI):

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- a) Provide UL Class (5 milliamp sensitivity) ground fault circuit protection on 120 VAC branch circuits for exterior location receptacles and for interior locations where required by NEC. (These may not be indicated on Panel Schedule.) This protection shall be an integral part of the branch circuit breaker which also provides overload and short circuit protection for branch circuit wiring. Tripping of a branch circuit breaker containing ground fault circuit interruption shall not disturb the feeder circuit to the panelboard. Provide separate neutral for circuits on GFI breakers whether indicated on drawings or otherwise.

- 7. Breakers feeding heating and air conditioning equipment shall be rated HACR type breaker.

2.5 SERVICE ENTRANCE EQUIPMENT

- A. Panelboards used as service entrance equipment shall be listed and labeled by UL for use as service equipment.

PART 3 - EXECUTION

3.1 PREPARATION/INSPECTION/EXAMINATION

- A. Verify that surface is suitable for panelboard installation. Do not install NEMA 1 equipment until building has reached the "dried-in" stage.

- B. Examine area to receive panelboard to assure adequate clearance for panelboard installation.

- C. Verify prior to installation that National Electrical Code clearances will be maintained after installation. Rework equipment locations as required to provide electrical code clearances.

- D. Start Work only after unsatisfactory conditions are corrected.

- E. Submit coordination drawings of all electrical rooms, showing all equipment. Comply with Section 26 05 00.

3.2 INSTALLATION

- A. Install panelboards in accordance with NEMA PB 1.1. Install all panelboards and panelboard enclosures in accordance with the manufacturer's written instructions, NECA's "Standard of Installation", the applicable requirements of the National Electrical Code, and recognized industry practices.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- B. Install panelboards plumb. Install recessed panelboards flush with wall finishes. Provide supports in accordance with Section 26 05 29 Supporting Devices.
- C. Panelboards shall be provided with structural framing located within gypsum board partitions. All enclosures shall be firmly anchored to walls and supporting structures (where used) using appropriate hardware. Provide supporting channels on walls constructed of gypsum board or where otherwise necessary to provide a mechanically secure and permanent installation. Attach channels to framing provided within gypsum board partitions.
- D. Enclosures shall be installed so that the top is 6'-6" above finished floor.
 - 1. Where the size of the enclosure is such that the top cannot be installed at 6'-6", the top of the enclosure shall be kept as low as possible.
- E. Panelboard backboxes/trim covers mounted adjacent to each other (i.e. multi-section panels, etc) installed in finished areas be of same size.
- F. Provide filler plates for unused spaces in panelboards.
- G. Provide typed circuit directory from panelboard manufacturers' original card stock, for each branch circuit panelboard. Mount a typewritten directory showing the actual circuit numbers, type of load and room names on inside of door. Room names shall be actual names or numbers used, not necessarily shown on the drawings. Progress Drawings shall show same arrangements as the Directory. Revise directory to reflect circuiting changes required to balance phase loads.
- H. Provide four each 1 inch spare conduits out of each recessed panelboard to an accessible location above ceiling. Identify each as SPARE.
- I. Clean the interior of each panelboard before installing conductors. At all times, keep the interior trim and exterior surfaces of the panelboard free of rust and debris. Repaint finishes if necessary.
- J. Coordinate all raceways and conductors with their respective panelboards so that all connections and conductors routing present an orderly appearance. Conductors in the panelboards shall be neatly laced and arranged in orderly manner.
- K. Collect all keys upon delivery of panelboard. Store keys on one ring to be kept by project superintendent. Forward key ring with keys to OAR at substantial completion.
- L. Provide a separate neutral conductor for each GFI breaker. These shall not be combined to serve more than 1 circuit, even where on different phases. Increase plan indications of conductors for neutral wires required, as necessary.
- M. Conduit or piping systems that contain water or liquid of any kind shall not be installed over the top of any electrical equipment, transformers, racks, cabinets, or enclosures without prior written approval from the Owner.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

3.3 IDENTIFICATION

- A. Refer to Section 26 05 53 Electrical Identification for products and content.
- B. Provide engraved plastic nameplates under the provisions of 26 05 53.
- C. Nameplate shall show panel name, voltage and name of panel that feeds this respective panel, and UL short circuit rating.

3.4 FIELD QUALITY CONTROL

- A. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. 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.
- C. All circuits shall be operated to establish a good working order and checked for shorts.
- D. All panel directory circuit numbers shall be checked to verify accuracy of the number.
- E. Tests:
 - 1. Test Panelboards and panelboard feeders per requirements of Section 26 08 13 Tests and Performance Verification.
 - 2. Feeder conductors shall be checked by approved means to establish the absence of shorts to ground; insulation value, etc. and the result recorded and submitted to the Designer.
 - 3. Submit Conductor Insulation Resistance Test per requirements of Section 26 08 13.
 - 4. Submit Tabulation Data Voltage and Amperage Readings per requirements of Section 26 08 13.
- F. Equipment Checkout:
 - 1. Where and when requested by Designer/OAR provide (during construction):
 - a) Inspection of equipment by authorized equipment manufacturer technician complete with submittal of statement of findings by technician, and providing any adjustments deemed necessary for a complete and operating system.
 - b) Submit Equipment Checkout Memo per Section 26 08 13.

3.5 ADJUSTMENT AND CLEANING

- A. Adjust operating mechanisms for free mechanical movement.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- B. Tighten bus connections and mechanical fasteners.
- C. Touch up scratched and marred surfaces to match original finish.

END OF SECTION 26 24 16

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

SECTION 26 41 13 - LIGHTNING PROTECTION FOR STRUCTURES

PART 1- GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Contractual Conditions and Division 01 Specification sections apply to this section.

1.2 SUMMARY

- A. This section includes the requirements for provision and installation of a complete lightning protection system.

1.3 DESCRIPTION

- A. A Lightning Protection System shall be provided and installed on the structure even though not shown on drawings, by experienced LPI Certified Installers in compliance with provisions of Code for Lightning Protection Systems as adopted by the National Fire Protection Association and Underwriters' Laboratories. All equipment to that result shall be included whether or not specifically called for herein with the additional requirement that the system shall meet all the requirements of LPI.
- B. Materials shall comply in weight, size and composition with the requirements of Underwriters' Laboratories and the National Fire Protection Code relating to this type of installation, and shall be UL Labeled.
- C. All materials, where available by any one manufacturer, shall be cast.
- D. System shall comply with the following:
 - 1. LPI
 - 2. ANSI/NFPA 780; Class I (Class II for buildings over 75 feet in height)
 - 3. UL 96A; Master Label for:
 - a. New installation

1.4 REFERENCES

- A. ANSI/NFPA 780 - Lightning Protection Code.
- B. ANSI/UL 96 - Lightning Protection Components.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- C. LPI - Lightning Protection Institute.
- D. UL 96A - Installation Requirements for Lightning Protection Systems.

1.5 SUBMITTALS

- A. Submit shop drawings showing layout of air terminals, grounding electrodes, and bonding connections to structure and other metal objects. Include terminal, electrode, and conductor sizes, and connection and termination details. Drawings shall include full layout of cabling and points, and connections.
- B. Submit product data showing dimensions and materials of each component, and include indication of listing in accordance with ANSI/UL 96.
- C. Submit manufacturer's installation instructions.
- D. Submittal shall include ground rods and ground wells as called for in Section 26 05 26 – Grounding and Bonding.

1.6 PROJECT AS-BUILT DOCUMENTS

- A. Record actual locations of air terminals, grounding electrodes, bonding connections, and routing of system conductors on red lined as-built documents.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specialized in lightning protection equipment with minimum five (5) years documented experience and member of the Lightning Protection Institute.
- B. Installer: Authorized installer of manufacturer with minimum five (5) years documented experience and member of the Lightning Protection Institute.

1.8 PRE-INSTALLATION CONFERENCE

- A. Convene a pre-installation conference one (1) week prior to commencing lightning protection work.

1.9 SEQUENCING AND SCHEDULING

- A. Coordinate the work of this Section with roofing and exterior and interior finish installations.

PART 2 - PRODUCTS

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

2.1 MANUFACTURERS

- A. Thompson Lightning Protection, Inc.: Premium Line.
- B. Independent Protection Company, Inc.: Premium Line.
- C. Heary Bros. Lightning Protection: Premium Lines.

2.2 MATERIALS

- A. Components: In accordance with ANSI/UL 96 and LPI.
- B. Air Terminals:
 - 1. Air Terminals shall be solid (aluminum) as required to match roof conductors, and shall have proper base support for surface on which they are attached, and shall be securely anchored to this surface.
 - 2. Terminal length: Comply with NFPA 780.
 - 3. Air Terminal for Chimneys: Lead-coated copper.
- C. Conductors:
 - 1. Roof conductors shall consist of aluminum complying with the weight and construction requirements of the Code. Roof conductor material shall match and be compatible with roof flashing material.
 - 2. Down conductors shall be copper, and shall be provided where shown installed in PVC conduit and hidden within the structure.
- D. Fastener: Conductor fasteners shall be of the same material as the conductor, having ample strength to support conductor.
- E. Connectors and Splicers: Bronze or aluminum as required to be compatible with conductor being connected.
- F. Ground Rods: Comply with all requirements of Sections 26 05 26.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are ready to receive work.
- B. Verify that field measurements are as shown on shop drawings.
- C. Beginning of installation means installer accepts existing conditions.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

3.2 PROTECTION OF SURROUNDING ELEMENTS

- A. Protect elements surrounding work of this Section from damage or disfiguration.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with UL 96A, ANSI/NFPA 780, and LPI.
- C. Install ground rods in accordance with Section 26 05 26. Where conflict exists between the requirements of Section 26 05 26 and this Section, the most stringent shall govern.
- D. Installation shall be made in an inconspicuous manner with conductors routed to conceal as much as possible. Down conductors shall be concealed within structure, and shall be run in 1" PVC conduit. See Paragraph 'F' below and NFPA 780 4.15.1.
- E. Where fasteners are to be mounted in masonry or structural work, they shall be furnished to the Masonry or Structural Contractor so they may be installed during construction of the project.
- F. Conductors concealed in steel reinforced concrete shall be installed and bonded per NFPA 780 4.15.3. Specific attention is brought to the requirements of 4.9.13 requiring down conductors to be connected to reinforced steel at its upper and lower ends.
- G. Lightning protection system shall be bonded to metal bodies as required by NFPA 780 4.21.
- H. Provide proper connections of lightning protection system to all grounded media in and around the protected structure per NFPA 780 4.20 "Potential Equalization".
- I. Provide proper grounding of all grounding media in, on and around structure to provide common ground potential per NFPA 780 4.14 including electric service, telephone and antenna system grounds as well as underground metallic piping systems, underground metal conduits, etc.
- J. Ground Ring: Bond to ground ring system. See Section 26 05 26. Items required to be bonded/connected in 'H' and 'I' above shall be bonded/connected via ground ring system where available and applicable.
- K. All exposed conductors located 6 ft. or less above finished floor or finished grade are to be suitably protected/shielded as well as other exposed locations where conductor is subject to mechanical damage.
- L. Coordinate and receive approval of all penetrations of roofing system and mounting to roofing system with Designer and Roofing Contractor prior to submittal of shop drawings.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- M. Coordinate and receive approval of all connections to structural steel, rebar, and other structural elements with Structural Engineer prior to submittal of shop drawings.
- N. Ground Terminals:
 - 1. Ground connections shall be made in accordance with requirements of all applicable codes and Section 26 05 26 (including but not limited to requirements for testing, ground rods, materials, wells, etc.).
 - 2. Ground rods shall be placed outside, a minimum of two (2) feet from building foundations. Top of rod shall be at least one (1) foot deep into earth (i.e., with minimum earth cover of one (1) foot).
 - 3. Each and every ground rod location shall consist of:
 - a. Two or more 30 ft. ground rods (5/8" copper) at no less than 30 ft. spacing shall be driven vertically to a depth resulting in one (1) foot earth cover.
 - b. Bond the two or more ground rods together with a cable size that meets the applicable requirements of NFPA 780 for Class I or II locations as applicable.
 - c. Provide additional rod electrodes as required to achieve specified ground resistance.
 - d. Complete installation shall exceed the minimum requirements of NFPA 780.
 - e. Provide grounding well enclosure at each ground rod location in accordance with Section 260526.

3.4 FIELD QUALITY CONTROL

- A. Test grounds per Section 26 05 26.
- B. Obtain UL Master Label and attach to building at location directed by OAR. Submit copy of paperwork to OAR and submit in O & M Manual.
- C. Submit test results on each ground location including final length of each ground rod and final distance between each installed ground rod at each ground rod location.

END OF SECTION 26 41 13

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

THIS PAGE INTENTIONALLY LEFT BLANK

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

SECTION 26 56 00
EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Exterior luminaries with lamps and ballasts.

1.3 DEFINITIONS

- A. CRI: Color-rendering index.
- B. HID: High-intensity discharge.
- C. Luminary: Complete lighting fixture, including ballast housing if provided.

1.4 SUBMITTALS

- A. Product Data: For each luminary and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of luminary, including materials, dimensions, effective projected area, and verification of indicated parameters.
 - 2. Details of attaching luminaries and accessories.
 - 3. Details of installation and construction.
 - 4. Luminary materials.
 - 5. Photometric data based on laboratory tests of each luminary type, complete with indicated lamps, ballasts, and accessories.
 - a. For indicated luminaries, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining luminaries shall be certified by manufacturer.
 - 6. Photoelectric relays.
 - 7. Ballasts, including energy-efficiency data.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

8. Lamps, including life, output, and energy-efficiency data.
9. Means of attaching luminaries to supports, and indication that attachment is suitable for components involved.

B. Operation and Maintenance Data: For luminaries to include in operation, and maintenance manuals.

C. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Luminary Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with IEEE C2, "National Electrical Safety Code."

D. Comply with NFPA 70.

1.6 WARRANTY

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

B. Special Warranty: Written warranty, signed by manufacturer and Installer agreeing to replace external parts of luminaries exhibiting a failure of finish as specified below. This warranty is in addition to, and not a limitation of, other rights and remedies Owner may have under requirements of the Contract Documents.

1. Protection of Metal from Corrosion: 5 year warranty against perforation or erosion of finish due to weathering.
2. Color Retention: 5 year warranty against fading, staining, and chalking due to effects of weather and solar radiation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- A. Refer to Luminaire Schedule on contract drawings.

2.2 LUMINARIES, GENERAL REQUIREMENTS

- A. Luminaries shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
- B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaries.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaries.
- F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.
- G. Exposed Hardware Material: Stainless steel.
- H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- I. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
- J. All types of labels (including manufacturers and UL) shall be concealed within the body of the fixture, or accessories. The labels shall not be seen from normal viewing angles. This includes company logos unless approved in writing by the engineer.
- K. All fixtures shall have gasketing material between lens door and frame to completely seal interior of fixture. Knockouts and holes in fixture housing shall be closed and sealed.
- L. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminary doors.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- M. Luminary Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminary before shipping. Where indicated, match finish process and color of pole or support materials.
- N. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.
- O. Factory-Applied Finish for Steel Luminaries: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
 - 2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
 - a. Color: As selected from manufacturer's standard catalog of colors.
- P. Factory-Applied Finish for Aluminum Luminaries: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - 2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
 - 3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
 - 4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
 - a. Color: Dark bronze. Confirm color with architect prior to purchase. Architect may choose from manufacturer's standard colors.

2.3 LED LIGHTS

- A. All LEDs used in the LED fixture shall be high brightness and of proven quality from established and reputable LED manufacturers.
- B. Manufacturer shall utilize an advanced production LED binning process such as Optibin® from Philips Color Kinetics to deliver a common and repeatable color point to

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

maintain color consistency from fixture to fixture and project to project over time, while ensuring a reliable supply of LEDs from the supplier.

- C. LED fixtures shall meet lumen maintenance standards as defined in IESNA LM-80-08.
- D. Manufacturer shall provide optical performance, polar diagrams, and photometric data in various formats including IES file format in accordance with IES LM-79-08.
- E. Photometric data shall be based on test results from an independent NIST traceable testing lab. IES data must be available and downloadable from manufacturer's Web Site.
- F. The luminary shall contain complete prewired integral drivers and an optical assembly that shall provide a distribution of Foot candle that is consistent with FBC.
- G. Labeling shall be in accordance with ANSI standards. All units shall be UL labeled.
- H. The Luminary shall meet ANSI 2G vibration standards.
- I. Finish shall be corrosion resistant polyester powder paint.
- J. The drivers shall be UL class II and operated in constant current mode. The drivers shall be prewired to the light engine. The Light engine assembly and housing shall be of the same manufacturer. The driver shall start and operate the light engine at ambient temperatures from -0 degrees to 50 degree Celsius.
- K. The system must survive 120 repetitive strikes of "B2" waveforms (IEEE/ANSI C62.41.1 1991 scenario 1 location category B) at one minute intervals with less than 10 percent degradation in clamping voltage.
- L. The light engine assembly shall consist of a precision die cast aluminum heat sink, metal core printed circuit board assembly, a precision formed optical assembly comprised of injection molded high specular reflectors. The Light engine assembly shall use high brightness light emitting diodes with average CCT of 6000K and CRI greater than 70.
- M. Manufacturer shall provide a 5 year warranty from date of substantial completion.
- N. Test shall be performed to verify lumen output, life and color properties, CCT and CRI and shall be tested and measured in accordance with LM-80. Lumens depreciation shall be in accordance with LM-80. Lumen maintenance projections shall not exceed 6X of the available system-level lumen depreciation test data. The system shall be rated at L70/B50 for not less than 50,000 hours.
- O. Manufacturer (other than the basis of design) shall provide revised photometrics for all areas to prove equal or greater photometric equivalency of the proposed LED luminaries. If additional luminaries are required, manufacturer will be responsible for all additional cost for the redesign or reconfiguration of the space.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

2.4 SUPPORT COMPONENTS, GENERAL REQUIREMENTS

- A. Luminary Attachment Provisions: Comply with luminary manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.
- B. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
 - 1. Materials: Shall not cause galvanic action at contact points.
 - 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, unless stainless-steel items are indicated.
 - 3. Anchor-Bolt Template: Plywood or steel.

PART 3 - EXECUTION

3.1 LUMINARY INSTALLATION

- A. Install lamps in each luminary.
- B. Install luminary in accordance with manufacturer's instruction to maintain wet location listing.
- C. Fasten luminary to indicated structural supports.
 - 1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- D. Adjust luminaries that require field adjustment or aiming.

3.2 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

3.3 GROUNDING

- A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
 - 1. Install grounding electrode for each pole, unless otherwise indicated.
 - 2. Install grounding conductor pigtail in the base for connecting luminary to grounding system.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 CLEANING AND ADJUSTING

- A. Clean units after installation. Use methods and materials recommended by manufacturer.
- B. Adjust amiable luminaires and luminaires with adjustable lamp position to provide required light distributions and intensities.

3.6 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.
 - 1. Verify operation of photoelectric controls.
- C. Illumination Tests:
 - 1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IESNA testing guide(s):
 - a. IESNA LM-5, "Photometric Measurements of Area and Sports Lighting."
 - b. IESNA LM-50, "Photometric Measurements of Roadway Lighting Installations."
 - c. IESNA LM-52, "Photometric Measurements of Roadway Sign Installations."
 - d. IESNA LM-64, "Photometric Measurements of Parking Areas."
 - e. IESNA LM-72, "Directional Positioning of Photometric Data."
- D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain luminaire lowering devices. Refer to Division 01 Section "Demonstration and Training."

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

END OF SECTION 26 56 00

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

THIS PAGE INTENTIONALLY LEFT BLANK

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

SECTION 26 56 13
LIGHTING POLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Poles and accessories.
- B. Related Sections include the following:
 - 1. Division 26 Section "Exterior Lighting" for exterior luminaries.
- C. The OUC Roadway lighting poles are specified specification 26 05 12.

1.3 DEFINITIONS

- A. Pole: Luminary support structure, including tower used for large area illumination.
- B. Standard: Same definition as "Pole" above.

1.4 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

- A. Dead Load: Weight of luminary and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-4.
- B. Live Load: Single load of 500 lbf (2224 N), distributed as stated in AASHTO LTS-4.
- C. Wind Load: Pressure of wind on pole and luminary, calculated and applied as stated in AASHTO LTS-4.
 - 1. Wind speed for calculating wind load for poles 50 feet (15 m) or less in height is 140 mph.

1.5 SUBMITTALS

- A. Product Data: For each luminary, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of luminary, including materials, dimensions, effective projected area, and verification of indicated parameters.
 - 2. Details of attaching luminaries and accessories.
 - 3. Details of installation and construction.
 - 4. Materials, dimensions, and finishes of poles.
 - 5. Means of attaching luminaries to supports, and indication that attachment is suitable for

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- components involved.
- 6. Anchor bolts for poles.
- 7. Manufactured pole foundations.

- B. Shop Drawings:
 - 1. Design calculations, certified by a qualified professional engineer, indicating strength of screw foundations and soil conditions on which they are based.

- C. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4 and that load imposed by luminary has been included in design.

- D. Operation and Maintenance Data: For poles to include in operation, and maintenance manuals.

- E. Warranty: Special warranty specified in this Section.

- 1.6 QUALITY ASSURANCE
 - A. Comply with IEEE C2, "National Electrical Safety Code."
 - B. Comply with NFPA 70.

- 1.7 DELIVERY, STORAGE, AND HANDLING
 - A. Store and handle all poles in accordance with manufacturer's instructions to avoid damaging poles during delivery, storage, and handling. Special attention should be given to any wrapping on the poles to make sure that the finishes are not damaged.

- 1.8 WARRANTY
 - A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranty requirements of the Contract Documents.

 - B. Special Warranty: Written warranty, signed by manufacturer and Installer agreeing to replace external parts of poles exhibiting a failure of finish as specified below. This warranty is in addition to, and not a limitation of, other rights and remedies Owner may have under requirements of the Contract Documents.
 - 1. Protection of Metal from Corrosion: 5 year warranty against perforation or erosion of finish due to weathering.
 - 2. Color Retention: 5 year warranty against fading, staining, and chalking due to effects of weather and solar radiation.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Metal Parts: Free of burrs and sharp corners and edges.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- B. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- C. Exposed Hardware Material: Stainless steel.
- D. Poles and concrete bases shall comply with applicable requirements of IES, NESC, ASCE, FBC, and including but not limited to their requirements for illumination, uniformity, construction, wind loading, pole setback, breakaway, installation, glare criteria.
- E. All types of labels (including manufacturer's and UL) shall be concealed within the body of the fixture, pole or accessories. The labels shall not be seen from normal viewing angles. This includes company logo's unless approved in writing by the engineer.
- F. Manufacturer shall provide a 5 year warranty from date of substantial completion.

2.2 POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS

- A. Structural Characteristics: Comply with AASHTO LTS-4.
 - 1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in Part 1 "Structural Analysis Criteria for Pole Selection" Article, with a gust factor of 1.3.
 - 2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaries and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.
- B. Provide in line fusing and lightning arrestor in the handhole of all poles.
- C. Luminary Attachment Provisions: Comply with luminary manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.
- D. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
 - 1. Materials: Shall not cause galvanic action at contact points.
 - 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, unless stainless-steel items are indicated.
 - 3. Anchor-Bolt Template: Plywood or steel.
- E. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."
- F. Power-Installed Screw Foundations: Factory fabricated by pole manufacturer, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole base flange and strength required to support pole, luminary, and accessories.
- G. Breakaway Supports: Frangible breakaway supports, tested by an independent testing agency acceptable to authorities having jurisdiction, according to AASHTO LTS-4.

2.3 ALUMINUM POLES

- A. Poles: Seamless, extruded structural tube complying with ASTM B 429, Alloy 6063-T6 with

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

access handhole in pole wall.

- B. Poles: ASTM B 209 (ASTM B 209M), 5052-H34 marine sheet alloy with access handhole in pole wall.
 - 1. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- C. Pole-Top Tenons: Fabricated to support luminary or luminaries and brackets indicated, and securely fastened to pole top.
- D. Grounding and Bonding Lugs: Welded 1/2-inch (13-mm) threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- E. Brackets for Luminaries: Detachable, with pole and adapter fittings of cast aluminum. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.
 - 1. Tapered oval cross section, with straight tubular end section to accommodate luminary.
 - 2. Finish: Same as pole.
- F. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.4 POLE ACCESSORIES

- A. Base Covers: Manufacturers' standard metal units, arranged to cover pole's mounting bolts and nuts. Finish same as pole.

PART 3 - EXECUTION

3.1 POLE INSTALLATION

- A. Align pole foundations and poles for optimum directional alignment of luminaries and their mounting provisions on the pole.
- B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features, unless otherwise indicated on Drawings:
 - 1. Fire Hydrants and Storm Drainage Piping: 60 inches (1520 mm).
 - 2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet (3 m).
 - 3. Trees: 15 feet (5 m).
- C. Lightning arrestor and in-line fusing are to be located at hand-hole location of pole for easy access.
- D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
 - 1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
 - 2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
 - 3. Install base covers, unless otherwise indicated.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

4. Use a short piece of 1/2-inch- (13-mm-) diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

E. Raise and set poles using web fabric slings (not chain or cable).

3.2 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINARIES

A. Install on concrete base with top flush with finished grade or surface at luminary location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 03 Section "Cast-in-Place Concrete."

B. Well fixtures shall be provided with minimum 6" depth of pea gravel below fixture for drainage or as required by manufacturer.

3.3 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

3.4 GROUNDING

A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole, unless otherwise indicated.
2. Install grounding conductor pigtail in the base for connecting luminary to grounding system.

B. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole.
2. Install grounding conductor and conductor protector.
3. Ground metallic components of pole accessories and foundations.

3.5 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.6 CLEANING AND ADJUSTING

A. Clean units after installation. Use methods and materials recommended by manufacturer.

3.7 FIELD QUALITY CONTROL

A. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

compliance with standards.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain luminary lowering devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 26 56 13

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

SECTION 27 05 00
COMMON WORK ELEMENTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 STIPULATIONS

- A. Project drawings and general provisions of the Contract, including but not limited to all; General and Supplementary Conditions, Division 01 Specification Sections and stipulated Specification Sections shall apply to this and all related Division 27 Specification Sections.
- B. Reference Symbols:
1. All device symbols are defined by the appropriate symbol schedule on the symbols and abbreviations sheet in the T-series Contract Drawings. Not all device symbols as indicated may be required for the project.
 2. Because of the scale of the drawings, symbols are shown on drawings as close as possible to the mounting location. Contractor shall coordinate exact location of all network systems and related components with all related Contract drawings, specifications and affected trades prior to submittal of shop drawings.
- C. Abbreviations:
- AGC: Automatic Gain Control
ADA Americans with Disabilities Act
AHJ: Authority Having Jurisdiction
AIDB Airport Integrated Data Broker
APC Automated Passport Control
APM Automated People Mover
ASC Airside Concourse
ASTM American Society for Testing Materials
ATP: Acceptance Test Plan
AWS: Advanced Wireless Service
A/V Audio Visual Systems – For purposes of this specification section A/V systems shall include all Media Management, Video Broadcasting, Intercommunications (Paging/Public Address, Clock, Auxiliary Sound), Video Intercom, Emergency Communications, Mass Notification, Multi-User Flight Information Displays (MUFIDS), and Internet Protocol Television (IPTV).
- BAS Building Automation System
BDA: Bi-Direction Amplifier
BIDS Baggage Information Display System. See also “MUFIDS.”
BICSI Building Industry Consultant Services International - International organization whose primary objective is to enhance the reputation and skills of companies and individuals employed in the telecommunications and security industries by ensuring that current and developing standards are maintained.
- BIDS Baggage Information Display System

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

CBP	Customs and Border Protection
CFR	Code of Federal Regulations
CPU	Central Processing Unit
CUPPS	Common Use Passenger Processing
CUSS	Common Use Self Service
CWDM	Coarse Wave Division Multiplexing
dB	Decibel
DAQ	Delivered Audio Quality
DAS	Distributed Antenna System
DDC	Direct Digital Controller / Device Display Controller
DP	Demarcation Point - The point of interface between the Communications Networks, IPTV, any Auxiliary Systems, and the associated Service Providers or Public Utilities. Also see "EF." Shall also serve as the primary termination point for all incoming OSP cabling as well as the primary main grounding busbar for all communications systems. Refer to project documents for exact location and termination requirements.
DSS	(Electronic) Dynamic Signage System
DWDM	Dense Wave Division Multiplexing
ECS	Emergency Communications System
EF	Entrance Facility. See also "DP."
ELFEXT	Equal Level Far End Crosstalk.
EME	Experiential Media Environment
EMI	Electromagnetic interference
EMT	Electrical Metallic Tubing – Also known as thin-wall conduit.
ER	Equipment Room – See also "MDF"
ESMR	Enhanced Specialized Mobile Radio
FAA	Federal Aviation Administration
FAAP	Remote Fire Alarm Annunciator Panel
FACP	Fire Alarm Control Panel
FAS	Fire Alarm System
FCC	Federal Communications Commission
FEXT	Far End Crosstalk
FIDS	Flight Information Display System. See also "MUFIDS."
GFCI	Ground fault circuit interrupter
GIDS	Gate Information Display System. See also "MUFIDS."
GTF	Ground Transportation Facility
GUI	Graphical User Interface – A specialized program employing graphical display maps of a facility and/or site which, also provides a manual user interface for all system functions and operations by utilizing control and annunciation icons from dedicated human machine interface terminals.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

HMI	Human/Machine Interface – A Computer-operated, video control terminal complying with FCC Part 15 CFR Title 47, Subparts A and B, and shall utilize multiple dynamic GUI based displays for annunciation and control LCD flat panel computer monitor or display screen as defined by related specification sections.
HTML	Hypertext Markup Language
IAMS	Integrated Airport Management System
IATA	International Air Transport Association - The global trade association for the airline industry
IBC	International Building Code
ICT	Information Communications Technology
IDF	Intermediate Distribution Frame – The room/space that shall serve as the local termination point for all horizontal and backbone cabling. Also shall be known as Equipment Room (ER), Horizontal Cross-Connect (HC) or Floor Distributor (FD).
IDS	Intrusion Detection System
IEEE	Institute of Electrical and Electronics Engineers
IO	I/O Input/Output
IP	Internet Protocol
IPTV	Internet Protocol Television
IR	Infrared
ISO	International Organization for Standardization
ITF	Intermodal Transportation Facility
Lab	Computer, Science, and/or Education Laboratory.
LAN	Local Area Network
LCD	Liquid Crystal Display
LED	Light-Emitting Diode
LIU	Light Interface Unit (also known as Fiber Optic Patch Panel)
LMR	Land Mobile Radio
LST	Landside Terminal
LTE	Long Term Evolution (Commonly known as “4G”)
LV	Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power- limited circuits.
Mbps	Megabits per second.
MCO	Orlando International Airport (IATA Code)
MDF	Main Distribution Frame – The room/space that shall serve as the primary termination point for all backbone cabling to each IDF locations and horizontal connection point for local communication drops. May also serve as a local IDF location as well as the cross-connection and interconnection of all entrance cables from the DP for all PSTN and WAN connections. Also shall be known as Main Cross Connect (MC), Telecommunications Room (TR) and/or Campus Distributor (CD)
M-JPEG	Motion – Joint Photographic Experts Group

GREATER ORLANDO AIRPORT AUTHORITY
 EMPLOYEE PARKING LOT
 ORLANDO, FLORIDA

MPEG	Moving picture experts group.
MTBF	Mean Time Between Failures
MUFIDS	Multi-User Flight Information Display System
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NEXT	Near End Crosstalk
NFPA	National Fire Protection Association
NRTL	Nationally Recognized Testing Laboratory
NTSC	National Television System Committee.
NVR	Network Video Recorder
NVW	Network Video Workstation
OAR	Owner's Authorized Representative
OFE	Owner-Furnished Equipment
OLT	Optical Line Terminal
ONT	Optical Network Terminal
OSP	Outside Plant Cabling
OTDR	Optical Time Domain Reflectometer
PA	Public Address System
PACS	Physical Access Control System
PDS	Premise Distribution System
PCS	Personal Communications System
POL	Passive Optical Local Area Network
PON	Passive Optical Network
POS	Passive Optical Splitter
POTS	Plain Old Telephone Service
PSTN	Public Switched Telephone Network
RCDD	BICSI-accredited Registered Communications Distribution Designer
PSN	Public Safety Network
RFI	Radio-frequency interference / Request for Information
RGS	Rigid Galvanized Steel conduit: Galvanized steel tubing, with a tubing wall that is thick enough to allow it to be threaded.
RoF	Radio-over-Fiber
RoHS:	Restriction of Hazardous Substances
RSL	Received Signal Level
RSSI	Received Signal Strength Indication
RSRP	Reference Signal Receive Power
RS-232	An ANSI/TIA standard for asynchronous serial data communications protocol between terminal devices. This standard defines a 25-pin connector and certain signal characteristics for interfacing computer equipment.
RS-485	An ANSI/TIA multipoint communications protocol standard.
SCADA	Supervisory Control and Data Acquisition
SLA	Service Level Agreement
SMR	Specialized Mobile Radio
SMS	Security Management System / Short Message Service
SNIR	Signal-to-Noise Interference Ratio
SNMP	Simple Network Management Protocol

GREATER ORLANDO AIRPORT AUTHORITY
 EMPLOYEE PARKING LOT
 ORLANDO, FLORIDA

SOW	Statement of Work
STC	South Terminal Complex
TCP/IP	A standard protocol stack on which the Internet and data communications networks operate
TGB	Telecommunications Grounding Busbar – Located in each
TMC	Technology Master Contractor -- a sub-contractor to the CMAR that shall have overall responsibility for performing and delivering all scopes of work as defined in the Division 27 and 28 specifications, T-series, TS-series and TA-series Contract Drawings and related Contract Drawings. Additionally the TMC shall have responsibility for the related scope of work in referenced Division 23 specification sections.
IDF	Intermediate Distribution Frame – See also “TR”
TIA	Telecommunications Industry Association
TMGB	Telecommunications Main Grounding Busbar
TP	Transition Point – A location in the horizontal cabling where flat under carpet cable transitions to a horizontal cabling consolidation point (CP).
TR	Telecommunications Room -- See also “IDF”
TPM	Technical Project Manager – A sub-contractor to the CMAR that shall assume responsibility for oversight of all Division 27 and 28 scopes of work and all related Divisions 23 and 26 scopes of work. The TPM shall serve as a single point-of-contact between the Authority/Owner’s Authorized Representative (OAR) and all Division 27 and 28 sub-contractors.
TSA	Transportation Security Administration
TSB	Technical Service Bulletin
TVSS	Transient Voltage Surge Suppressor
UHD	Ultra High Definition
UPS	Uninterruptible Power Supply
UTP	Unshielded Twisted Pair
VDGS	Visual Docking Guidance System
VLAN	Virtual Local Area Network
VoIP	Voice Over IP telephone Network
VPN	Virtual Private Network– A technique made possible by switching technologies that permits the logical grouping of any number of network devices into one or more sub-networks.
VSS	Video Surveillance System
VSWR	Voltage Standing Wave Ratio
WAN	Wide Area Network
WAP	Wireless Access Point
WLAN	Wireless Local Area Network
WSP	Wireless Service Provider
10BASE2	10 Mbps data throughput over coaxial cable.
10BASE-T	10 Mbps data throughput over twisted pair cable.
10BASE-FL	10 Mbps data throughput over fiber.
100BASE-T	100 Mbps data throughput over twisted pair cable.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

100BASE-TX	100 Mbps data throughput over Category 5 twisted pair or greater.
100BASE-FL	100 Mbps data throughput over fiber.
1K-BASE-T	1Gbps data throughput over Category 5 twisted pair or greater.
1K-BASE-LX/LH	1Gbps data throughput over 9-micron single mode fiber.
1K-BASE-ZX:	1Gbps data throughput over 8-micron single mode fiber.
10GBASE-T	10Gbps data throughput over Category 6A/6e twisted pair or greater.

D. Definitions:

1. Contract Documents: The documents consisting of the Form of Agreement between Authority and Contractor, Conditions of the Contract, (General, Supplementary, and other Conditions), Drawings, Specifications and all Addenda issued prior to the execution of the Contract.
2. Contract Drawings: The drawings that form a part of the Contract Documents that provides the graphical representation of the project requirements intended design and/or performance criteria to be delivered by the Contractor.
3. Reference Drawings: A drawing and/or set of drawings produced by a proprietary supplier, manufacturer, subcontractor, or fabricator included in the Contract Documents for informational purposes, providing specific information related to the installation of related appurtenances, components, devices, hardware, products, and/or systems. Reference Drawings shall also include any Contract Drawings from prior bid packages that may have pertinent information or require coordination of trades related to this contract.
4. Shop Drawings: A drawing and/or set of drawings produced by the contractor, supplier, manufacturer, subcontractor, or fabricator as a detailed representation of the proper installation of the related, appurtenance, component, device, hardware, product, and/or system to be delivered in conformance to the requirements of the Contract Documents.
5. The Authority: Greater Orlando Aviation Authority (GOAA) (Owner).
6. Authority Vendor (GOAA Vendor): Third party supplier/provider contracted directly by The Authority to provide goods or services as part of this project.
7. Contractor: The Technology Master Contractor (TMC)
8. Furnish: Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
9. Install: Receive, Unload, verify, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
10. Provide: Furnish and install, complete and ready for the intended use.

1.2 SUMMARY

- A. This Section contains the overall requirements associated with all Division 27 and related Division 28 Specification Sections.:

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- B. In addition to the requirements of Division 1, this section shall address further requirements for submittals, quality assurance, product handling, record documents, project conditions, installation, system performance, demonstrations, testing, and certifications for all scopes of work related to network communication cabling for this project scope of work. Refer to related Division 26, 27 and 28 specification sections and all contract drawings for additional requirements.
- C. It shall be the responsibility of the Contractor to furnish and install all necessary cabling, conduits/raceways, cable terminations, controls, systems, materials, devices, components, electrical power, equipment racks/cabinets and software as well as all appurtenances, programming, commissioning and testing necessary to deliver a complete and fully operational communications network infrastructures and systems as indicated by the contract documents.
- D. The installation, performance, features, functions, software, licenses, and programming criteria as specified herein as well as all related drawings and Division 27 and 28 specification sections have been designed to offer the maximum system efficiency, ease of operation, occupant safety and the protection of equipment as recommended by the Authority and Owner's Authorized Representative (OAR).
 - 1. Any deviations from the specified criteria shall be documented, reviewed, and agreed to in writing by the Authority and OAR prior to submission of bids. Refer to Division 01, and all related Division 27 and 28 Specification Sections for any substitutions and/or project deviation requests.
 - a. The required information shall include but not be limited to: reason for deviation, all differences in performance, operation, and function from the herein specified requirements, all benefits, and added features to the Authority and OAR as a result of the deviations and any additional incurred costs to the Authority for maintenance and long term ownership.
 - b. Failure to provide the Authority and OAR with the required information shall result in any shop drawing submissions being returned for non-conformance with the contract requirements.
 - 2. The submission of a bid or proposal for this work shall serve as acknowledgement that the Contractor and all Sub-Contractors have read, understood and accepted all of the General Conditions, Special Requirements, General Requirements, and all related specification sections and in the execution of all work shall be bound by all of the conditions and requirements therein.
 - a. Prior to the submission of a Bid or proposal for this work, all anomalies, inaccuracies, discrepancies or inconsistencies noted within these Contract Documents shall be brought to the immediate attention of the Authority and OAR in written form. The submission of a bid or proposal for this work shall serve as acknowledgement that, apart from any such anomalies, inaccuracies, discrepancies or inconsistencies noted, the Contractor and all Sub-Contractors believe the Contract Documents to be complete and sufficient to provide a complete and fully-functional project as intended by the Authority.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- b. During the execution of all work, the Contractor shall immediately notify, in written form, the Authority and OAR of any and all anomalies, inaccuracies, discrepancies or inconsistencies discovered within the Contract Documents. The Authority shall not be responsible for any additional costs associated with correcting any such anomalies, inaccuracies, discrepancies or inconsistencies incurred as a result of a delay by the Contractor in notifying the Authority and OAR of any such discovery.
 - c. Where ambiguity exists within the Contract Documents, the most stringent requirement and/or that which is superior in system design and performance shall prevail, and shall be delivered by the Contractor at no additional expense to the project.
- E. All device symbols are defined by the appropriate symbol schedules as indicated by the symbol and abbreviation drawing sheets for each discipline. The Contractor shall coordinate exact locations with all architectural, mechanical, electrical, reflected ceiling, furniture drawings and door hardware specifications as well as all affected trades prior to submittal of bids.
- 1. All symbols are shown on the contract drawings as close as possible to their intended location. Contractor shall coordinate with GOAA and GOAA's Vendor the installation of all equipment, devices, controls, components, cabling conduits/raceways and integration of other systems along with all affected trades and specified system sub-contractors. The contractor shall document all coordination requirements at the time of shop drawing submission.
 - 2. Drawings for this work are diagrammatic and intended to convey the extent, general arrangement, and locations of the work. Because of the scale of the drawings, certain basic items such as access panels, conduits, cabinet sizes, penetration sleeves, pull boxes, back-boxes and junction boxes may or may not be shown on the contract drawings. Include all items where required by code and related specification sections for proper installation of all work.
- F. Project specifications and drawings may not deal individually with every part, control, device, component, or appurtenance which may be required to produce the equipment performance for the specified system and/or as required for compliance with all specified systems integration.
- 1. Include such items and components, as required, for complete operational systems as defined by the project documents, whether specifically indicated or not. Subject to the responsibility matrices shown on the Contract Drawings, the Contractor shall be responsible for providing conduits/raceways, cable terminations, controls, systems, equipment, materials, devices, components, electrical power, equipment racks/cabinets, software, programming, commissioning, testing and all appurtenances as well as the integration of any ancillary systems or Authority provided equipment/components/systems.
 - 2. Coordinate with other applicable trades in submittal of shop drawings and the installation of all systems. All shop drawings shall detail space conditions in order to accommodate other concerned trades, all equipment locations are subject to final review by the Authority and OAR.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- G. All Division 27 and 28 scopes of work shall include all necessary labor, coordination and interfacing with other trades and existing systems, software, equipment, materials, devices, cabling, conduits and electrical power as well as the performance of all system programming, testing and commissioning as required to provide fully operational systems in accordance with all requirements of the project documents.
1. Coordinate the installation of all systems, equipment, components, materials, conduits, cabling, devices and all existing system modifications with the Authority and OAR prior to the submission of any shop drawings.
 2. All Division 27 and 28 systems work shall include the labeling of all wire terminations, cabling, patch cords, pathways, enclosures, racks and cabinets in accordance with the Authority labeling standards, requirements and guidelines. All wiring shall terminate on fixed terminal strips, punch blocks, or patch panels in accordance with all requirements of the project drawings and related specifications.
 - a. No splices shall be permitted in underground maintenance holes and non-accessible junction boxes. All junction boxes containing any system splices shall be uniquely identified.
 - b. All mounting heights and accessibility to all equipment requiring access by individuals with disabilities shall comply with ANSI A117.1 requirement.
 - c. All equipment enclosures located outside or in all areas with high moisture or high humidity shall be NEMA 4X enclosures and rated for that application.
 - d. All interior devices exposed to the general population shall be installed in secured equipment enclosures and installed in such a manner that resists tampering and/or removal without the use of specialized tools.
 3. All work shall be neat in appearance, free of rough edges, scratches, blemishes, cracks and exposed gaps. All equipment shall be secured to the mounting surface, and fastened with hardware approved by the manufacturer and capable of supporting the rated load. All backbone/permanent cables within enclosures shall be neatly routed and tie wrapped at 6 inches on center. Patch cables shall be secured with hook-and-loop (Velcro) or wire management guides. All wire splices shall be terminated on terminal strips and/or soldered in place. Any splices utilizing wire nuts or crimp/pressure-type connectors shall not be acceptable.
- H. Use of Premises
1. Refer to Specification Section 01 10 00 in addition to the following.
 2. The Contractor shall design, prepare, schedule, and coordinate all scopes of work without disruption of any existing system functions or the daily operation of the existing facility. All cabling and equipment shall be installed in such a manner that all new controls, equipment and/or devices shall be installed, programmed and tested prior to modification, switch over and/or disconnecting of any existing systems.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- a. Include all costs related to any phased construction methodologies having to do with the scope of work defined herein, including, but not limited to, all necessary temporary equipment, devices, components or systems as well as any labor costs associated with any installation, commissioning, testing demolition of any technology systems required to be performed outside of normal business hours of the facility, Contractor or Sub-Contractors.
 - b. Prior to the disabling, modifications, switchover and/or demolition of any existing system components and/or cabling, all new system components, equipment, conduits, cabling, shall be in place, tested and fully operational.
 - c. The contractor shall coordinate all installation activities so as not to disrupt the daily operations of the airport and shall include any costs related to a phased construction methodology where applicable. Installation activity and costs shall include but are not limited to all necessary temporary equipment, devices, components or systems as well as any labor costs associated with any installation, commissioning, testing demolition of any systems required to be performed outside of normal business hours of the facility, Contractor or Sub-Contractors.
 - d. Contractor shall submit a Utility Outage Notice (UON) following GOAA UON protocol prior to any system disruptions.
3. Contractor shall plan, schedule and install all scopes of work in accordance with all requirements of the project construction schedule. Refer to related specification sections for additional information related to project scheduling and facility access.
- a. The contractor shall coordinate all installation and demolition activities so as not to disrupt the daily routine of the existing facility or negatively impact the integrity of the facility's security and life safety measures.

I. Coordination

1. The Contractor shall coordinate with all other affected trades in the submittal of comprehensive shop drawings and the installation of all equipment, devices, and systems. All shop drawings shall detail space conditions in order to accommodate all impacted trades, all equipment and device locations are subject to final review by the Authority and OAR.
 - a. If installation of equipment, enclosures, raceways, cable trays and/or conduits is performed prior to submission and/or approval of shop drawings, the Contractor shall make any adjustments or corrections as indicated in the shop drawing review at no additional cost to the Authority.
 - b. If installation of equipment, raceways, cable trays, and/or conduit is performed prior to coordination with all other trades, which interferes with work of other trades or the performance of the system, the contractor shall make necessary changes to correct the condition at no additional cost to the Authority.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- c. Provide all cabling, conduits, terminations, and programming to properly interface the BAS, fire alarm, emergency communications system (ECS) and access control systems with all related mechanical, elevator fire and security systems in accordance with all applicable life safety codes and/or in accordance with all requirements of the project drawings and related specifications.
- d. Coordinate with all affected systems providers to ensure the proper integration and performance requirements of all Division 28 systems as required by Code, Contract Documents, and the AHJ.
2. Where applicable, contractor shall coordinate all service, rework, and relocation of existing utilities. Bid shall include all work required for any connections/interfaces with existing systems and/or utilities.
 - a. Contractor shall coordinate all work with vendors for rework, relocation, and addition of equipment and devices, including any modification to existing system infrastructure.
3. Coordinate all work involving tenant leased areas or equipment for rework, relocation, and addition of equipment and devices, including any modification to existing system infrastructures with the Authority and OAR.
4. Communication rooms including, but not limited to, MDF, IDF and control room spaces require activation in advance of other portions of the project to facilitate installation and commissioning of Authority-furnished and Authority Vendor-furnished equipment, Division 23 building automation / building management systems, and selected other systems. The Contractor shall schedule all work impacting communications room spaces to ensure completion adheres to the Project Schedule.
5. Refer to 3.1 Coordination for additional information.

1.3 SCOPE OF WORK

- A. Refer to individual Specification Sections for further system requirements.
- B. Authority-Furnished Equipment (Owner-Furnished Equipment (OFE))
 1. Refer to Specification 27 10 00 Paragraph 1.3.
 2. The Contractor shall coordinate with the Authority and OAR for pick-up of all OFE to be installed by the Contractor. The Contractor shall coordinate with the Authority in advance for specific pick-up location of OFE and to obtain access to such locations. The Authority shall not be responsible for delivery of OFE to be installed under this contract to the construction site. The hand-off of OFE between the Authority and the Contractor may occur multiple times throughout the project to permit configuration by either party after delivery and prior to installation.
 3. Immediately inspect all OFE upon pick-up for damage and/or defects. Notify the Authority and OAR in writing of any damage or defects immediately upon discovery. The contractor shall assume full responsibility for any unreported damage and/or defects to OFE.
 4. The Contractor shall provide all vehicles, hand trucks, carts and other means of transporting OFE within the project site. The Contractor shall transport OFE from the point of delivery to the point of installation.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

5. Refer to Part 1 Delivery, Storage and Handling requirements of this specification section and all related Division 27 and 28 specification sections for additional requirements.
 6. Refer to Part 3 Protection requirements of this specification section and all related Division 27 and 28 specification sections for additional requirements.
- C. Authority and Authority Vendor-Furnished Equipment and Services
1. Portions of this project shall be furnished and installed by the Authority and/or Authority Vendors. The contractor shall identify elements of the project provided by Authority and/or Authority Vendors that impact the contractor's scope of work and coordinate all work with such parties. Schedule work to permit authority vendors' access to required work areas with sufficient time to complete tasks in accordance with the Project Schedule. Refer to related specification sections for additional information.
 2. The Authority Vendor shall actively attend meetings to coordinate work and construction with the Contractor.
 3. The Authority Vendor shall provide all equipment, tools, and services to complete work as described in the Contract Documents.
- D. Where listed on the drawing, the following components shall be defined as follows:
1. Network Components: GOAA will furnish and install all required network switches and other active elements for network connectivity. The network includes layer 2 access and distribution or layer 3 core and router switches to connect a system to the GOAA Passive Optical Lan and Local Area Network.
- E. The Contractor shall coordinate with the OAR for work related to any GOAA furnished, GOAA installed, and GOAA vendor work.

1.4 REFERENCES

- A. References to industry and trade association standards as well as all building codes are minimum installation requirements. The codes, standards and agencies listed below shall form a part of all related specification sections and all work shall comply with the latest adopted standards.
- B. Authority Having Jurisdiction: The system shall comply with all applicable Codes, Ordinances and Standards as interpreted and enforced by the local authority having jurisdiction.
- C. Local Adoption and Amendments: Follow the locally adopted version of all codes and standards. Where local jurisdictions or governments include amendments to codes including the National Electrical Codes, national health & safety codes, radio frequency regulations, or other building codes, the Contractor shall follow the locally amended versions and amendments.
- D. Publication Dates: Comply with published standards in effect as of date of the Contract Documents unless otherwise indicated.
 1. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity.
 2. Copies of applicable standards are not bound with the Contract Documents.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

3. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.
- E. Where the contract drawings and specifications mandate a greater requirement or performance than those specified by any of the below referenced codes and standards, the Contract Documents shall then be the governing requirements for this project. The minimum codes and standards to be applied for this project shall be the following;
1. National Fire Protection Association (NFPA):
 - a. NFPA-70: National Electrical Code (NEC)
 - b. NFPA-72: National Fire Alarm and Signaling Code
 - c. NFPA-75: Standard for the Protection of Information Technology Equipment
 - d. NFPA 76: Standard for the Fire Protection of Telecommunications Facilities
 - e. NFPA-101: Life Safety Code
 - f. NFPA 1221: Standard for the Installation, Maintenance and Use of Emergency Services Communications Systems
 - g. NFPA 780: Standard for the Installation of Lightning Protection Systems
 2. American National Standards Institute (ANSI) / Telecommunications Industry Association (TIA):
 - a. ANSI/TIA-455-61 FOTP-61: Measurement of Fiber or Cable Attenuation Using an OTDR
 - b. ANSI/TIA-455-78 FOTP-78 / IEC 60793 Optical Fibers Part 1-40: Measurement Methods and Test Procedures, Attenuation
 - c. ANSI/TIA-526-7: Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant (Method A)
 - d. ANSI/TIA-526-14-C: Measurement of Optical Power Loss of Installed Multimode Fiber Cable Plant
 - e. ANSI/TIA-568-D.0 : Generic Telecommunications Cabling for Customer Premises
 - f. ANSI/TIA-568-D.1: Commercial Building Telecommunication Standard
 - g. ANSI/TIA-568-D.2: Balanced Twisted-Pair Telecommunication Cabling and Components Standard
 - h. ANSI/TIA-568-D.3: Optical Fiber Cabling Components
 - i. ANSI/TIA-569-D: Telecommunications Pathways and Spaces
 - j. ANSI/TIA-606-B: Administration Standard for Telecommunications Infrastructure
 - k. ANSI/TIA-607-C: Commercial Building Grounding and Bonding Requirements for Telecommunications
 - l. ANSI/TIA-758-B: Customer Owned Outside-Plant Telecommunications Infrastructure Standard
 - m. ANSI/TIA IS-811: Telephone Terminal Equipment, Performance and Interoperability for VoIP Feature Telephones.
 - n. ANSI/TIA-854: Full Duplex Ethernet Specification for 1000Mbps Operating Over Category 6 Balanced Twisted Pair Cabling
 - o. ANSI/TIA-862-A: Building Automation Systems Cabling

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- p. ANSI/TIA-1005-A: Telecommunications Infrastructure Standard for Industrial Premises
- q. ANSI/TIA-1152: Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
- r. ANSI/TIA-1183: Measurement Methods and Test Fixtures for Balun-Less Measurements of Balanced Components and Systems
- 3. International Telecommunication Union
 - a. ITU-T G.984: Gigabit Passive Optical Networks (GPON)
 - b. ITU-T G.987: 10-Gigabit Capable Passive Optical Network (XG-PON)
- 4. Motorola
 - a. R56 Standards and Guidelines for Communication Sites
- 5. Americans With Disabilities Act (ADA) 2014 ADAAG.
- 6. Underwriters Laboratories, Inc.:
 - a. UL 486A: Wire connectors and soldering lugs for use with copper conductors
 - b. UL 1449: Transient Voltage Surge Suppressors
 - c. UL 1581: Standard for Electrical Wires, Cables, and Flexible Cords
 - d. UL 1666: Standard for Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts
 - e. UL 478: Standard for Electronic Data-Processing Units and Systems
 - f. UL 83: Thermoplastic-Insulated Wires and Cables
 - g. UL 910: Test Method for Fire and Smoke Characteristics of Cables Used in Air-Handling Spaces." Provide products which are UL-listed and labeled.
 - h. UL 969: Standard for Marketing and Labeling.
 - i. UL Certified: UL's LAN Cable Certification Program
- 7. International Code Council
 - a. Florida Building Code 5th Edition (2014) Accessibility
 - b. Florida Building Code 5th Edition (2014) Building
 - c. Florida Building Code 5th Edition (2014) Energy Conservation
 - d. Florida Building Code 5th Edition (2014) Mechanical
 - e. Florida Building Code 5th Edition (2014) Plumbing
- 8. Florida Fire Prevention Code, 5th Edition (2014)
- 9. Institute of Electrical and Electronic Engineers (IEEE)
 - a. IEEE 802.1, Bridging and Management
 - b. IEEE 802.3, Standard for Ethernet (2012 with published amendments)
 - c. IEEE 802.11 Wireless LANs
- 10. NEMA/ICEA Compliance:
 - a. WC-5 - "Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy,"
 - b. WC30 - "Color Coding of Wires and Cables," pertaining to control and signal transmission media.
- 11. Internet Networking Standards: Network hardware and software shall be able to communicate with the Internet and provide for the creation of IP based networks for the Authority. All supplied hardware shall comply with the following minimum standards and RFC's as appropriate.
 - a. RFC 950 - Internet Standard Sub-Netting Procedure
 - b. RFC 1140 - Official Protocol Standards

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- c. RFC 1156 - MIB Base for IP Networks
 - d. RFC-1213 - MIB-II
 - e. RFC-1757 - Remote Monitoring (RMON)
 - f. RFC 1157 - Simple Network Management Protocol
 - g. RFC 1720 - TCP/IP, OSI Compliant
 - h. RFC 1918 - Address Allocation for Private Subnets
 - i. RFC 1583 - OSPF, Version II
 - j. RFC 1723 - RIP -II
12. ASTM Compliance: Comply with applicable requirements of D-2219 and D-2220. ASTM Compliance: Comply with applicable requirements of D-2219 and D-2220.
13. Building Industry Consulting Service International (BICSI)
- a. ANSI/BICSI-002, Data Center Design Standard and Recommended Practices
 - b. Electronic Safety and Security Design Reference Manual (ESSDRM)
 - c. Information Technology Systems Installation Manual (ITSIMM)
 - d. Outside Plant Design Reference Manual (OSPDRM)
 - e. Telecommunications Distribution Methods Manual (TDMM)
14. Safety Code for Elevators and Escalators – American Society of Mechanical Engineers (ASME 17.1).
15. Federal Communications Commission:
- a. FCC Regulations Part 15 Title 47.
 - b. FCC: Federal Communication Commission Part 68 as modified by Wiring Docket 88-57.
- F. Refer to Specification 27 10 00 and the contract documents for additional information regarding the scope of work under this contract, and for information regarding items to be furnished by the Authority, which shall be designated as “Owner Furnished Equipment (OFE)”.
1. The following line items shall be defined as follows:
- a. Headend And Software: Includes any servers, management/administrative software, software licenses, and components which serve the purpose of performing system-wide coordination, monitoring, data processing, control and other global functions. Refer to related specification sections for additional information.
 - b. Integration to Existing System: Includes all hardware, software, wiring, cabling, programming, protocol converters, interface devices and appurtenances as required to extend the physical or logical scope of an existing system, or to incorporate a new or disparate system into an existing system. Refer to related specification sections for additional information.
 - c. Interfaces: Includes all hardware, software, wiring, cabling, programming, interface devices and appurtenances as required for communication between systems, or between a given system and an operator to provide the specified functionality. Refer to related specification sections for additional information.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- d. Network Switch: Includes layer 2 (access / distribution) or layer 3 (core / router) network switches to connect a system to the GOAA Passive Optical Lan (POL) / Local Area Network (LAN). Refer to related specification sections for additional information. Where noted as “PON”, this line item shall include Passive Optical LAN active components including Optical Line Terminals (OLTs) and Optical Network Terminals (ONTs).
 - e. Backbone Cable: The segment of the premises distribution system that provides connection between telecommunications spaces. Refer to specification section 27 10 00 for additional information.
 - f. Horizontal Cable: The segment of the premises distribution system that provides connectivity from communications rooms to field devices. Refer to specification section 27 10 00 for additional information.
 - g. Field Devices: Components of a system which are served by the system headend and are the network endpoint or “edge” device. Refer to individual specification sections for additional information.
- G. Additional System specific requirements may be included in the Sections referenced in 1.1. The Contractor shall meet the requirements in this Section in addition to those specific requirements for each System. Where common work results within this Section conflict with Sections listed in 1.1, the more stringent shall apply.

1.5 SYSTEMS DESCRIPTIONS

- A. Refer to individual specification sections for systems descriptions.

1.6 SUBMITTALS

- A. In addition to all submittal requirements as stipulated by Division 01 and any related specifications sections, the Contractor shall provide all submittals in accordance with the following:
 - 1. The Authority and OAR approvals shall be obtained for all equipment and material before delivery to the job site. Delivery, storage, or installation of equipment or material which has not had prior approval will not be permitted at the job site.
 - 2. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings, and other data necessary for the Authority and OAR to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.
 - 3. Prior to any submission the contractor shall be responsible for performing the following quality control items to ensure compliance with all project requirements:
 - a. Review all Shop Drawings and Product Data
 - b. Review all field measurement criteria.
 - c. Review all field construction criteria and methodologies.
 - d. Review all catalog numbers and similar data.
 - e. Review all coordination requirements of affected trades.
 - f. Review conformance to all appropriate specification sections.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

4. The contractor shall have a registered RCDD professional review and seal shop drawings related to network installations, testing, certifications, and structured cabling layouts for communications systems confirming that the proposed network infrastructure is in conformance with all stipulated standards and requirements as herein specified. Failure to provide RCDD sealed shop drawings shall result in all shop drawings being returned for resubmission without any reviews taking place.
 5. Submit all system testing, commissioning and startup procedures to be employed. Include all estimated times for performance of all tests, all test equipment and manpower necessary for testing.
 6. Submit all sub-contractor qualifications and certifications in accordance with the requirements as specified elsewhere in this specification section.
- B. The Contractor shall schedule submittals to maintain the project schedule. For coordination requirements refer to Division 01 Specification Section, which outline basic submittal requirements and coordination. All Division 01 and related Specification Sections requirements shall be used in conjunction with all requirements as herein specified.
1. Submittals shall be provided as a complete submission; no partial submissions will be accepted. Failure to provide a complete submission shall result in all submittals being returned for resubmission.
 2. No substituted equipment shall be reviewed without prior approval in accordance with the requirements of "substitutions" under Division 1 Specification Section.
 3. Mark the submittals, "SUBMITTED UNDER SECTION__."
 - a. Submittals shall be marked to show specification reference including the section and paragraph numbers.
- C. All shop drawings shall be prepared using latest version of AutoCAD or REVIT, drawn accurately, and in accordance with the Authority's Standards and the requirements of Specification Section 01 33 23. Failure to provide a complete set of "Contractor prepared" installation drawings at the time of submittal shall result in all submittals being returned for resubmission.
1. Submission Packaging: The Contractor shall organize the submissions according to the following packaging requirements.
 - a. Electronic Copy Submission: One complete set of electronic equipment data sheets and drawings submitted in PDF format and collated in two distinct files:
 - 1) Equipment Data Sheets, equipment schedules, alarm matrixes cable termination spread sheets, and all related pertinent information.
 - 2) Drawings including all site plans, floor plans, risers, point to point wiring, grounding, installation details, rack/cabinet and mounting elevations.
- D. Re-submittals

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

1. Submitted items, found unsuitable, rejected or returned for revision by the Authority and OAR, shall be reworked by the Contractor and resubmitted.
2. Review of Contractor's submittals by the Owner's Representative will be limited to examination of an initial submittal and one (1) resubmittal. The Authority and/or OAR reserves the right to obtain reimbursement from the Contractor for amounts paid to the Owner's Authorized Representative for evaluation of any additional resubmittals due to incomplete information or non-compliance to the project documents on the part of the Contractor. An incomplete submittal (whether an initial submittal or a resubmittal) shall count as a submittal.

E. Shop Drawings

1. Provide all shop drawings shall include sufficient information, clearly presented, to determine full compliance with all project drawings and specifications. At the minimum include the following information as applicable for review. Failure to provide all information listed below shall result in all shop drawing submittals being returned for resubmission:
 - a. All Building Floor and Site Plans.
 - b. All equipment, devices and components with manufacturer's name(s), model numbers,
 - c. All equipment, device and component electrical ratings and power requirements
 - d. All equipment, device, and component performance ratings.
 - e. All equipment /device battery calculations,
 - f. All equipment /device cable voltage drop calculations,
 - g. All dB losses for all fiber optic devices and cabling,
 - h. All dB losses for all coaxial cabling taps and devices
 - i. All Speaker taps, voltages and zoning
 - j. All equipment rack/cabinet layouts and rack/cabinet sizes.
 - k. All device-mounting elevations.
 - l. All device wiring details.
 - m. All grounding and bonding connections.
 - n. Complete point-to-point-wiring diagrams for all systems. Include all equipment and wiring termination schedules and/or matrices.
 - o. Equipment, devices, cabling, and work related to Authority and Authority-Vendor furnished and/or installed work.
2. Provide a complete set of "contractor prepared" installation drawings. Drawings at the minimum shall consist of all floor plans indicating all passive and active electronic component locations, field devices, device identifications, distribution racks, patch panels, control panels, auxiliary control panels, power supplies, conduits, cable trays, and cabling distribution, as well as all 120-volt electrical circuit locations and designations.
 - a. Drawings shall be made at 1/8" = 1'-0" scale. Drawings shall include at the minimum the following:
 - 1) Detailed equipment layouts for all communications rooms. Coordinate all room layouts with affected trades.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- 2) Floor plan drawings showing locations of all equipment, devices, equipment cabinets and/or rack locations. Identify type and sizes of all equipment cabinets and/or racks.
 - 3) All cable tray layouts, including methods of support, and conduit routing of all conduits 2 inches in diameter or greater.
 - 4) All equipment rack layouts showing locations of all rack mounted equipment items.
 - 5) System riser diagrams and single line drawings, showing detailed connections for all parts of the system, including wire numbers, terminal block numbers and layouts, and other designations and codings (point-to-point wiring diagrams). System performance measurements shall be documented as specified.
 - 6) Equipment wattage for each location and rack/cabinet and estimated BTU production.
 - 7) Detailed equipment layouts for all equipment consoles. Indicate all equipment locations, power connections, data connections and installation details.
 - 8) All equipment mounting hardware/brackets and installation details, identify type size, load capacities of all mounting hardware/brackets; include all mounting and installation details, all space requirements, any special architectural modifications required.
 - 9) Outline drawings of all equipment cabinets/racks showing the relative position of all major components, all-wiring and grounding terminations. Include all panel, cabinet and/or rack dimensions.
 - 10) Point-to-point wiring diagrams for all cabling. Include all cable drop identification at edge device and at termination equipment. Include complete wiring termination schedules.
 - 11) All grounding and bonding termination points
 - 12) All electrical circuit numbers and distribution panel locations.
 - 13) Equipment, devices, cabling, and work related to Authority and Authority-Vendor furnished and/or installed work.
3. Provide a complete termination schedule of all communications device drop/outlet locations. Indicate on the installation drawings all device drops/outlet locations, termination room locations, unique identifications, cable types, cable distances and all pertinent data to properly evaluate the performance and capabilities of each cable run.
 4. All drawings shall be prepared using an AutoCAD- or REVIT-based program; hand drawn mark-ups of the original Contract Drawings shall not be acceptable. Failure to provide a complete set of "contractor-prepared" shop drawings at the time of submittal shall result in all submittals being returned for resubmission.
 5. All shop drawings shall include input from related trades for coordination. Related trades include, but are not limited to architectural, structural, mechanical, electrical, plumbing, fire protection, interiors, FFE, signage, wayfinding, and similar elements.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

F. Equipment Submittals:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
 - a. Include all equipment data sheets pertinent to equipment provided. All data sheets shall be highlighted and annotated indicating specific equipment and options supplied. Failure to provide the proper annotation of all equipment shall result in submittals being returned for resubmission.
2. Submit complete technical data necessary to evaluate the material and equipment. Include a complete technical specification for the submitted equipment, noting differences and adherence to this Section. Failure to provide the required data will result in all submittals being returned for resubmission.
3. Submit performance data, equipment ratings, cable requirements, control sequences, GUI based control panels, programming matrices, logic diagrams and all other descriptive data necessary to describe the installation and operations of the system being provided. Failure to provide the required data will result in all submittals being returned for resubmission.
4. Parts list, which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price, and availability of each part.
5. Installation Instructions: indicate application conditions and limitations of use stipulated by the applicable NRTL. Include instructions for storage, handling, protection, examination, preparation and installation.
6. Equipment, devices, cabling, and work related to Authority and Authority-Vendor furnished and/or installed work.

G. Maintenance and Operation Manuals: Submit in accordance with all requirements of Division 01 Specification Section and as herein specified.

1. Maintenance and Operation Manuals: Submit as required for systems and equipment specified in the technical sections. Furnish four copies, bound in hardback binders, (manufacturer's standard binders) or an approved equivalent. Furnish one complete manual as specified in the technical section but in no case later than prior to performance of systems or equipment test, and furnish the remaining manuals prior to contract completion.
2. Inscribe the following identification on the cover: the words "Maintenance and Operations Manual", include 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.
3. Provide a "Table of Contents" and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
4. Furnish (1) copy of all Maintenance and Operation Manuals in PDF format on DVD media or flash drive.
5. The manuals shall include:

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
 - b. A control sequence describing start-up, operation, and shutdown.
 - c. Description of the function of each principal item of equipment.
 - d. Installation and maintenance instructions.
 - e. Safety precautions.
 - f. Diagrams and illustrations.
 - g. Testing methods.
 - h. Performance data.
 - i. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
 - j. Contractor contact information.
 - k. Appendix; list qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.
6. Approvals will be based on complete submission of manuals together with shop drawings.

1.7 QUALITY ASSURANCE

- A. Quality Assurance services as described below shall be provided by the Contractor. The Authority will only provide Quality Assurance inspection.
1. Quality Assurance services described in this section are a portion of the quality assurance activities which may be necessary to achieve full compliance with the Contract Documents and are not intended to limit the activities of the contractor.
 2. These provisions do not relieve the contractor of providing quality control services or other inspections to the Authority or authorities having jurisdiction over this project.
- B. Cable Installer Qualifications: The cable installation contractor shall demonstrate not less than five (5) years' experience in the installation of structured cabling systems.
1. The installing contractor shall have on staff a minimum of one full time member that holds a current BICSI level II installer credential in good standing that has been active for a minimum of two (2) years and that has been employed by the Contractor for a minimum of one (1) year..
 2. NOTE: The installation of all communications cabling shall be under the direct supervision of a current BICSI level II installer who shall be knowledgeable in the following technical applications:
 - a. The Routing and installation of inside and outside plant shielded, unshielded, twisted pair, coaxial and fiber optic cables.
 - b. Bonding and grounding of cable tray and equipment racks.
 - c. Fusion splicing of fiber optic cabling.
 - d. Testing copper conductors for electrical continuity.
 - e. Testing and Certifying of UTP structured cabling for attenuation and worst case near end cross talk.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- f. Testing and Certifying of ALL fiber optic cabling employing an Optical Time Domain Reflectometer (OTDR) in accordance with TIA/EIA protocols.
 - g. Testing and Certifying of coaxial cable networks for RF leakage
 - h. Termination, connection, and testing of shielded and un- shielded twisted pair cable, coaxial cabling, and fiber optic cabling on all specified connectors, electrical protection blocks, termination blocks, and patch panels.
 - i. Generally accepted industry standards, as well as manufacturers written installation instructions, will be used for in-process quality control and final acceptance of the work installation.
3. Installing Contractor shall be currently licensed as a Certified Electrical Contractor or Certified Limited Energy System Specialty Contractor (ES 069).
 4. The Installing Contractor shall maintain an office within fifty (50) miles of the project with a permanent, local staff of specialists, including a Superintendent, for planning, installation and service and the capability to provide emergency service 24 hours per day, 7 days per week.
- C. Manufacturer's Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and materials specified for this project, and shall have manufactured the items for at least five (5) years.
- D. Non-Compliance
1. The Authority may notify the Contractor of any non-compliance with the foregoing requirements. The Contractor shall, after receipt of such notice, immediately take corrective action. Any notice, when delivered to the Contractor or its representative at the site of the work, shall be considered sufficient notice.
 2. If the Contractor fails or refuses to comply promptly, the Authority may issue an order stopping all or part of the work until satisfactory corrective action has been taken. It is understood and agreed to the following:
 - a. Time lost due to any such stop order is the responsibility of the Contractor.
 - b. Costs to repair, replace or otherwise remedy the defective work are the responsibility of the Contractor.
 - c. Costs incurred by the Authority to correct defective work shall be deducted from the total amount due the Contractor. An amount may be withheld from the payment due the Contractor to recoup expenses incurred by the Authority due to non-compliance.
 3. Failure of the Authority to notify the Contractor of non-compliance does not relieve the Contractor of the responsibility to comply fully with the requirements of the Contract Documents and does not preclude the Authority from taking the corrective action specified in this paragraph.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

4. In cases where implementation of the Quality Assurance Program does not comply with either the Contractor's Quality Assurance Plan or the Contract Provisions, or where the Contractor fails to properly operate and maintain an effective Quality Assurance Program, the Authority may:
 - a. Order the Contractor to replace ineffective or unqualified quality control personnel.
 - b. Assign the Authority or contracted outside professional staff to carry out the functions and operations of the Contractor's approved Quality Assurance Plan. Costs incurred by the Authority to operate a Quality Assurance Program or to otherwise remedy the Contractor's non-compliance with quality-related provisions of the contract shall be deducted from the total amount due the Contractor.

1.8 DELIVERY, STORAGE AND HANDLING

- A. In addition to the requirements below, refer to specific related specification sections for additional requirements.
 1. Contractor shall store all equipment and materials in a climate controlled environment. Storage environment shall, at a minimum, comply with the following:
 - a. Temperature not to exceed: -20° C to +70° C (-4° F to + 158° F)
 - b. Relative humidity of 5% to 95%, non-condensing.
 2. Where manufacturer's storage requirements are more restrictive than those listed above, store such equipment and/or materials in compliance with all manufacturer's requirements.
 3. Do not store equipment or materials in areas where fire or explosion hazards exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers. Do not store equipment or materials in areas subject to corrosive agents, liquids or gasses.
 4. Do not store equipment or materials in areas that contain potential water hazards (including, but not limited to, restrooms, kitchens, or mechanical spaces), or adjacent to liquid-carrying pipes.
- B. Contactor shall store materials only in areas designated by the Authority and OAR.
- C. The Contractor shall coordinate and participate in product delivery and movement to installation locations with the Authority and OAR within both on- and off-hour periods as required to minimize impact to the Airport operations.
- D. The Contractor shall be responsible for product shipment, delivery and storage/staging/testing location onsite. The Contractor shall coordinate with the Authority and OAR regarding site readiness and refer to architectural drawings regarding placement.
- E. The Contractor shall provide a security plan for approval by the Authority and OAR describing the methods, areas, and access for equipment. The plan shall include how equipment will be securely stored and accessed by the Contractor, GOAA, and OAR within communications rooms, MDFs, IDF, control rooms, and similar spaces throughout construction.

1.9 RECORD DOCUMENTS (AS-BUILT DOCUMENTS)

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- A. In addition to all general provisions of the Contract, including but not limited to all; General and Supplementary Conditions, Division 01 Specification Sections include the following project requirements;
- B. Project Record Documents
 - 1. Provide record documentation to the Authority and OAR at the completion of each phased installation and at Contract Closeout. To ensure that this submittal reflects proper record keeping during the Work, maintain on-site one (1) set of the Contract Drawings, specifications, addenda, change orders and other modifications to the Contract, and reviewed shop drawings and product data.
 - 2. Legibly mark and record at each specification section a description of actual products installed, including the manufacturer's name and product model number, product substitutions or alternates approved and utilized, and changes made by Addenda and Modifications.
 - 3. Legibly mark Record Documents and shop drawings to record actual installation including communication conduit, cabling and pathways used, field changes of dimensions and detail, changes in details from those indicated on drawings, details not on original Contract Drawings, and provide make and model of actual product installed.
 - 4. Mark whichever drawing is most appropriate to showing "field" conditions fully and accurately. If necessary, provide scaled drawings of modifications and give attention to concealed work, which would be difficult to measure and record later. Note related change order numbers where applicable. Organize record drawing sheets into manageable sets, and print suitable titles, dates, name of installing company, name and signature of job superintendent, and other identification on the cover of each set.
- C. As-Built Documentation
 - 1. Provide complete set of finalized copies of record documents prior to final acceptance of the project by the Authority and OAR in accordance with all requirements of Division 01 specification sections. At the minimum the as-built documents shall contain all information, data, and drawings as described in the "Submittals" paragraph of this specification section as well as all shop drawing requirements of related specification sections.
 - a. As-built documents shall be submitted in both paper and electronic media formats in the quantities as specified by Division 01 specification requirements.
 - 1) All electronic record drawings shall be prepared and submitted utilizing an AutoCAD- or REVIT-based program as manufactured by Autodesk. Where electronic documents are prepared using other than an AutoCAD or REVIT program manufactured by Autodesk, the contractor shall provide to The Authority and OAR the necessary software to electronically view the submitted documents.
 - 2) All electronic data sheets, control sequences, programming matrices and other descriptive data shall be provided in PDF formatted documents.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- 3) Copies of all current system programming and associated software shall be provided on downloadable media formatted for the use in restoration all system operations and functionality in the event of a catastrophic failure.
2. As-Built documentation shall include finalized equipment locations, cable and conduit routing pathways, and installation details. The As-Built documentation shall not be redlined copies, but be finalized AutoCAD or REVIT drawings. The As-Built documentation shall build on the initial design details and further develop these based on specific installation details.
3. As-Built documentation shall be capable of being inserted into the Authority GIS system.
4. The level of detail defined in these As-Built documents shall be suitable to allow any third party to support system maintenance as well as support future integration and expansion of installed systems at the Airport.
5. All junction boxes containing any system splices shall be uniquely identified in the field and indicated on the as-built drawings with corresponding schedule identifying all related splices at the specific junction box locations.

1.10 OPERATION AND MAINTENANCE

- A. Refer to specific related specification sections for requirements in addition to the following.
- B. Provide complete set of operating and maintenance manuals in accordance with all requirements of Division 1 and related Division 27 and 28 specification sections. The manuals shall include all operational programming and maintenance information for the system being provided. Edit all manuals specific to the installation of the provided system; manufacturer's documentation alone shall not be acceptable. Include all, manufacturer's technical data sheets, programming matrixes and graphic screen representations.
- C. Operations Manuals
 1. Provide a clear and concise sequence of operation that gives, in detail, the information required to properly operate all equipment and systems. Include detailed programming matrixes, indicating at the minimum all manual and automatic functions for all system, components and devices comprising the system being provided.
- D. Maintenance Manuals
 1. Include maintenance instructions and other descriptive material as received from the manufacturer to enable designated personnel to maintain and test equipment.
 2. Include descriptions, specifications, layout drawings (showing component types and positions), and back-panel and assembly wiring diagrams.
 3. Provide instructions for preventative maintenance procedures that include examinations, tests, adjustments and periodic cleaning.
 4. Provide guidelines for isolating the causes of hardware malfunctions and for localizing faults.

1.11 SPARE MATERIAL

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- A. In addition to all general provisions of the Contract, including but not limited to all; General and Supplementary Conditions, Division 01 Specification Sections refer to related Specification Sections “Extra Material” for specific requirements.
- B. All spare materials shall be provided at the time of final acceptance of the project and a signed packing list shall be obtained at the time of delivery. At no time is the contractor to use the spare materials provided for this project to replace malfunctioning or damaged equipment and or components.

1.12 ENVIRONMENTAL CONDITIONS

- A. Systems, components, devices materials, and equipment shall be capable of withstanding the environmental conditions of the space without mechanical or electrical damage or degradation of operating capabilities or performance.
- B. All devices, components, or equipment installed on the exterior of the facility shall be provided in accordance with all manufacturers’ requirements to ensure the proper operation when exposed to the environmental conditions and/or average annual highest and lowest temperature that can be anticipated for the geographic region of the facility, as well as anticipated temperatures within a sealed enclosure exposed to direct sunlight.
 - 1. Interior, Controlled Environment: System components, installed in temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of 2 to 50 °C (36 to 122 °F) dry bulb and 20 to 90 percent relative humidity, non-condensing and shall utilize NEMA 250, Type 1 enclosures.
 - 2. Interior, Uncontrolled Environment: System components installed in non-temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of -18 to 50 °C (0 to 122 °F) dry bulb and 20 to 90 percent relative humidity, non-condensing and shall be installed in NEMA 250, Type 4X enclosures.
 - 3. Exterior Environment: System components, conduits and back-boxes installed in locations exposed to weather shall be rated for continuous operation in ambient conditions of -34 to 50 °C (-30 to 122 °F) dry bulb and 20 to 90 percent relative humidity, condensing. Rated for continuous operation where exposed to rain as specified in NEMA 250, winds up to 240 km/h (149 mph) shall utilize NEMA 250, Type 4X enclosures.
 - 4. Hazardous Environment: System components, conduits and back- boxes located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers shall be rated, listed, and installed according to NFPA 70.
 - 5. Corrosive Environment: System components, conduits, and back- boxes subjected to corrosive fumes, vapors, and wind-driven salt spray in coastal zones, shall utilize NEMA 250, Type 4X enclosures.
 - 6. Submersible Environment: System components, conduits and back-boxes subjected to prolonged submersion in water, shall utilize NEMA 250, Type 6P enclosures.
 - 7. Areas where equipment and devices may be subject to damage by the general population shall be installed in vandal resistant enclosures; all fire alarm system and related devices shall be provided with wire guards.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

8. Console: All console equipment shall, unless noted otherwise, be rated for continuous operation under ambient environmental conditions of 15.6 to 29.4 °C (60 to 85 °F) and a relative humidity of 20 to 80 percent.

PART 2 - PRODUCTS

2.1 MANUFACTURED PRODUCTS

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, that meet and/or exceed the specified performance and features of the equipment and/or systems and for which replacement parts shall be readily available to the contractor and/or using agency. The equipment specified is based on the acceptable manufacturers listed. Where "or equal" is stated, equipment shall be equivalent in every way to that of the equipment specified, and subject to approval.
1. When more than one unit, device, or component of the same class of equipment is required, such units, devices, or components shall be the product of a single manufacturer.
 2. Acceptable manufacturers for each system shall be as specified and shall be provided in full compliance with the requirements of this and all related specification sections and contract drawings.
 - a. Manufacturers listed as acceptable shall not negate the contractors' responsibility for providing all equipment, devices, components, and/or systems, in accordance with all functions and performance requirements of the Contract Documents.
 - b. Where manufacturer and/or manufacturer model numbers reference specific system components in the related specification sections, it is to establish the performance requirements and quality of the systems and components only.
 - 1) It is in no way an inference that the referenced model numbers are the manufacturer's current product and are the only acceptable components for this project unless specifically referenced as "no substitutions."
 - c. Equivalent UL- listed equipment may be substituted for the approved manufacturers unless stipulated by other Specification Sections as "No Substitutions." All substitutions shall be submitted for approval by the Authority and OAR in accordance with all requirements of Division 01 Specification Sections and "Submittals" chapter of this Specification Section.
 - 1) Where systems and/or components are referenced as "no substitutions" the specific system and/or components shall be provided.
 - 2) All substitutions shall comply with all requirements as specified above and all system performance standards shall be maintained.
 - 3) The contractor shall stipulate the following information impacted by such a substitution.
 - a) Any and all extensions in time impacted by the substitution.
 - b) Any changes to the architectural or structural elements to the project

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- c) Differences in operation and/or performance from intended system criteria. Note all deviations from the requirements of the Contract Documents on the Compliance Matrix. Provide sufficient detail to enable thorough review of how the proposed equipment or solution differs from the requirements of the Contract Documents.
 - 4) Failure to provide the required substitution information shall result in “without consideration” the immediate rejection of the substituted equipment and/or systems.
 - 3. Due to the rapid advancement and antiquation of hardware technology, the supplied hardware shall be the “contemporary technical and operational equivalent” of the specified hardware. The following requirements shall be met:
 - a. Contemporary technical and operational equivalent shall be based on a comparison of technology at the time of publication to the technology at the time of ordering the equipment.
 - b. Hardware shall be ordered as close to the actual installation date for a given phase as reasonable (i.e., latest responsible date). Final hardware approval and scheduled order date are at the sole discretion of the Authority and OAR.
 - c. Hardware equivalence shall be based on both technical equivalence and operational equivalence.
 - d. Contemporary technical equivalence shall be based on device performance and class specifications.
 - e. Contemporary operational equivalence shall be based on industry standards, maintainability and functions.
 - 4. The Manufacturer's product or product line/series shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years. The Authority and OAR reserves the right to require the Contractor to submit a list of installations where the products have been in operation for the specified period of time prior to approval of shop drawings.
 - a. The manufacturers shall submit the appropriate documentation certifying that the installing sub-contractor is a qualified service provider of all manufacturers' products being provided for this project.
 - b. The Manufacturer shall certify that the submitted product will continue to be fully supported for a minimum of (5) years after acceptance by the Authority and OAR.
- B. Equipment Assemblies and Components:
 - 1. Components of an assembled unit need not be products of the same manufacturer.
 - a. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
 - b. Components shall be compatible with each other and with the total assembly for the intended service.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- c. Constituent parts which are similar shall be the product of a single manufacturer.
 - d. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.
- C. Electrical Components, Devices and Accessories
- 1. Shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Compatibility and Interoperability of System Components and Devices
- 1. Where multiple components, devices, and/or systems are intended to be interconnected and components of a complete system in accordance with any related specification sections, it shall be the Contractor's responsibility to verify interoperability and compatibility of said components, devices, and/or systems in full conformance to the specified performance criteria prior to the submission of shop drawings.
 - 2. Where specified devices are found to be incompatible or incapable of performing as specified in a seamless manner, the contractor shall notify the Authority and OAR in writing prior to submission of shop drawings. Failure to properly identify such functional discrepancies shall not relieve the contractor from providing a complete and fully functional system in accordance with the requirements of all related specification sections.
- E. Where Factory or Off-Premises Testing of any equipment, product or assembly is recommended by the product manufacturer or where specified as part of this section and/or any related specification section:
- 1. The Authority and OAR, shall have the option of witnessing all factory tests. The Contractor shall notify the Authority and OAR at a minimum of thirty (30) working days prior to the performance of any factory or off-premises tests.
 - a. Where the factory or assembly point for all off-premises testing is not within two (2) hours driving time from the project location, the contractor shall include as part of this project all per diem costs (travel, meals and lodging) for two representatives from the Authority and OAR to witness all testing. Any travel overseas shall include business-class airfare. Lodging shall consist of 3-star or better accommodations.
 - 2. Provide four (4) copies of certified test reports containing all preliminary test data and testing procedures shall be furnished to the Authority and OAR prior to any final testing and not more than ninety (90) days after completion of any tests.
 - 3. When equipment, product, or assembly fails to meet any factory or off-premises tests, retesting of equipment, product, or assembly shall be mandated, the manufacturer/contractor shall be liable for all additional expenses, including all expenses incurred by the Authority and OAR for witnessing the retesting of any equipment, product, or assembly.

PART 3 - EXECUTION

3.1 COORDINATION

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- A. Coordinate with all trades at the time of shop drawing submission detailing all space and/or room conditions. The contractor shall coordinate with the appropriate trade all conditions impacting the installation of any system including but not limited to all equipment locations, ceilings, lighting fixtures, fire protection piping, and ductwork layouts to the satisfaction of all concerned trades, subject to final review by the Authority and OAR.
 - 1. Coordinate exact location of all desktop/counter mounted equipment with the Authority and OAR, as well as all affected trades and tenants prior to the installation of any equipment and/or cabling.
 - 2. Coordinate exact location(s) of all ceiling mounted cable, conduits, cable tray, equipment, and/or devices with all architectural plans, reflected ceiling plans and affected trades prior to installation.
 - 3. For equipment installations requiring coordination with other trades, the contractor shall provide all supplemental framing, bracing, templates, backboxes and equipment anchor bolts for mounting or flush mounting preparation, (e.g. pedestals or other devices requiring mounting on walls, concrete pads or other materials). Coordinate delivery of templates and equipment anchor bolts to preclude any delay in the construction schedule or the work of the affected trade.
 - 4. If installation of equipment, raceways, cable trays, J-hooks and/or conduit is performed prior to coordination with other trades, which interferes with work of other trades or operation and maintenance of the facility, make necessary changes to correct the condition at no additional cost to the Authority.
 - 5. Contractor to provide all component MAC addresses to GOAA IT in device labeled floor plans and spreadsheet form for GOAA IT network configuration.
- B. Prior to final programming of all systems review with the Authority and OAR all system features, functions, system operations and related operational programming for all systems provided.
- C. Provide coordination with all system sub-contractors and trades for the proper installation of all equipment, components, and all integration requirements in order to provide fully operational systems in accordance with all applicable specification sections.
- D. Each Contractor shall maintain a complete set of current and up to date shop drawings and equipment submissions at the job site at all times. Shop drawings and all other submissions shall be made available to the Authority and OAR upon request.
- E. Coordinate the work of this contract with the work of the Authority and all Authority Vendors. Schedule all work to ensure that the work of the Authority and all Authority Vendors can proceed in accordance with the Project Schedule.
 - 1. All communications room spaces including, but not limited to IDF, MDF and control rooms spaces shall be constructed and complete six (6) months ahead of project substantial completion in order to allow the Authority and Authority Vendors to complete additional work within these spaces. Refer to Section 01 01 00 for early completion requirements. Completion shall, at a minimum, include the following elements:

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- a. The room shall be secured in accordance with the approved Security Plan described in 1.8 Delivery, Storage and Handling.
- b. The following work items relating specifically to these spaces shall be completed as part of this requirement:
 - 1) Architectural finishes
 - 2) Secure doors
 - 3) Electrical Power
 - 4) Grounding and Bonding
 - 5) Mechanical Systems
 - 6) Fire Suppression
 - 7) Equipment Racks and Cabinets including, but not limited to complete installation, bonding and labeling. All work within equipment racks and cabinets shall be complete including, but not limited to installation and labeling of patch panels, patch cables, wire management, surge protectors, and similar work.
 - 8) Premise Distribution System Backbone Cabling including, but not limited to complete installation, termination, testing, labeling, and programming of any PDS cabling and pathways within, terminating, or routing through the space. Work shall also include all terminations, cross-connects, securing, and fiber channeling for a complete and operational backbone system. Backbone PDS shall be entered in the GOAA PDS Administration Database.
 - 9) Final Cleaning
- c. Notify the Authority and OAR upon completion of each communications room space to obtain written acceptance. Rooms shall not be considered complete until final written acceptance is issued by the Authority and OAR. Acceptance for the purposes of this section does not constitute turnover of the space to the Authority. The contractor shall still be responsible for the space and any additional work required to complete the project.

3.2 EQUIPMENT PROTECTION

- A. Protect all materials, equipment, devices, or components permanently installed and/or stored on the job site. Protect all materials, equipment, cabling, devices, or components during construction and after installation. Provide appropriate protection of all materials, equipment, components, and/or devices until time of substantial completion. All materials, equipment, components and/or devices shall be protected during shipment and storage against any physical damage, dirt, moisture, extreme temperatures, precipitation, theft and/or vandalism:
 - 1. During installation, enclosures, racks/cabinets, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of any foreign matter; and shall be vacuum cleaned both inside and outside before testing and operating and repainting if required.
 - 2. Any materials, equipment, components and/or devices, stored on site, which have been deemed by the Authority and OAR to exhibit any indications of damage or exposure dust or moisture shall not be installed and shall returned to the source of supply for immediate replacement.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- a. The use of spare parts or the return of defective equipment for repair to mitigate the damage of defective materials, equipment, components, and/or devices shall not be acceptable. All materials, equipment, components, and/or devices shall be new and unused until final acceptance by the Authority and OAR.
 3. Provide and apply protective material immediately upon receiving the products and maintain throughout the construction process.
 - a. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
 - b. Any damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired area is not obvious or detectable.
 4. Failure to properly protect all materials, equipment, components and/or devices prior to final acceptance shall constitute sufficient cause for rejection of materials, equipment, components and/or devices should any defects, damage or degradation in performance is observed.
- B. Seismic Performance: The Contractor shall furnish and install all equipment bracing, and anchoring rated for the seismic zone of the geographical area in which the project resides, and shall withstand the effects of earthquake motion and wind forces in accordance with the current editions of the IBC and ASCE/SEI 7. Refer to Refer to Division 01 and Division 26 – Hangers and Supports for additional seismic information and requirements.
1. Equipment shall include, but not be limited to, racks/cabinets, video monitors, TV's, cable trays, conduits, junction boxes, and all associated appurtenances.
- C. Immediately replace all malfunctioning materials, equipment, components, and/or devices with new unused products up until the time the Authority and OAR issues final acceptance of the system. The returning of any malfunctioning equipment, devices, and/or components to the manufacturer for repair and then reinstallation at the project site shall not be acceptable.
1. All replacement materials, equipment, components, and/or devices shall be factory new and not obtained from the Project's spare parts inventory or use factory recycled products unless expressly identified by contractor prior to replacement and approved beforehand by the Authority and OAR.
- ### 3.3 WORK PERFORMANCE
- A. Receipt, storage, transport, handling, installation, final termination, testing, start-up and commissioning of all systems, system components and cabling infrastructures shall be under the direct supervision of the appropriate system sub-contractor. The sub-contractor shall be an accredited and authorized distributor of the appropriate equipment manufacturer and shall be fully certified in the installation, testing, commissioning, and programming of all equipment, devices, components, and/or systems being provided as part of this project.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- B. Job site safety and worker safety is the responsibility of the Contractor. Ensure that safe access and egress from all work areas is maintained during movement and installation of materials. Clean up all debris generated by installation activities. Keep all communications equipment rooms free of debris at all times. Communications rooms are not to be used for the storage of tools or project materials at any time during the project.
- C. Pre-installation Conferences: Include provisions to attend all Preconstruction/Preinstallation conferences at Project site in compliance with all requirements in Division 01 Specification Section and as herein specified. Review methods and procedures related to installation and operations of all communications systems, including, but not limited to, the following:
 - 1. Inspect and discuss electrical and equipment roughing-in related to all communications systems as well as other preparatory work required to be performed by other trades.
 - 2. Review and discuss all work, equipment deliveries, installation procedures, and related scopes as required to conform to the phased construction schedule.
 - 3. Review sequence of operations for each type of system, control, cabling and/or integration to any systems and/or equipment provided by other trades.
 - 4. Review and finalize construction schedule and verify availability of materials, installation personnel, equipment, and any preparatory work by other trades needed to make progress and avoid delays.
 - 5. Review required start-up, testing, commissioning, and certifying procedures to be employed for each system and any impacts to other trades.
- D. For work on existing facilities, arrange, phase, and perform work to assure the operation of all communications systems for other buildings and contiguous spaces at all times. Refer to Division 01 Specification Section for additional requirements.
- E. All new work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Division 01 Specification Section.
- F. Remove all unnecessary tools and equipment, unused materials, packing materials, and debris from each area where work has been completed unless designated for storage.
- G. Coordinate the installation of all cabling, conduits/raceways and cable trays and equipment with applicable trades to ensure proper operation and function of all integrated systems in accordance with all related specification sections. Refer to Division 01 Specification Section for additional project coordination requirements.
 - a. Prior to the final programming of any systems review with The Authority all system features, functions, system operations, network mapping, system integrated responses and all related programming as required for the proper operation of the respective communications systems.
- H. The Contractor shall prepare the necessary documents required for installing, testing, and bringing each system online. Such documents include but are not limited to:

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

1. Project management and quality assurance plans
 2. Testing plans
 3. Component and system submittal documents
 4. Installation plans
 5. Component design plans
 6. System user documentation
 7. As-built drawings and documentation
 8. Authority-required documentation including, but not limited to Cable Management Reports and Device Schedules.
- I. The Contractor shall coordinate with the Authority and OAR to ensure each system meets the project requirements. The Contractor shall meet all ADA requirements.

3.4 EQUIPMENT INSTALLATION

A. General

1. The Contractor shall provide all tools and test equipment required to install, verify, and test the installation and to determine that it meets the specifications. The Contractor shall furnish all necessary materials required to implement and to achieve the required work performance.
2. The Contractor shall install products detailed in the specifications, system requirements, drawings and Contractor designs including those purchased by the Contractor and those provided by other parties.
3. All equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the Specification shall be subject to the control and approval of the Authority and OAR.
4. All system equipment installations shall be in accordance with good engineering practices, NEC, local building codes, industry standards and all manufacturer's requirements. Cable terminations at all equipment locations shall comply with all state and local electrical codes and industry standards. All wiring shall test free from all grounds, shorts, stray voltages, and EMI.
5. Follow manufacturers' instructions for installing, components and adjusting all equipment and cabling. Submit two (2) copies of such instructions to the Authority and OAR a minimum of fourteen (14) days before installing any equipment related to the submitted instructions. Provide an additional copy of such instructions at the equipment during any work on the equipment. Where no instructions are included with the equipment, follow accepted industry practices and workmanlike installation standards.
6. Equipment location shall be as close as practical to locations as indicated on the contract drawings.
 - a. Provide all equipment clearances in accordance with NEC requirements and industry standards. Arrange equipment to facilitate unrestricted access for maintenance and service around all equipment, components, and/or cable terminations.
7. Where the Authority and OAR determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the project.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- a. "Conveniently accessible" is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.
 8. System/Hardware and mounting must comply with IBC Seismic Requirements.
 9. Comply with manufacturer's published rated load for all fasteners, brackets, enclosures, racks, cabinets, cable trays and supports for system components.
 10. For equipment mounted in drawers or on slides, provide the interconnecting cables with a service loop of not less than three feet and ensure that the cable is long enough to allow full extension of drawer or slide.
 11. The Contractor's quality assurance Inspector shall conduct a visual inspection of all installations to verify that the installations are in accordance with the project's and manufacturer's specifications. Records of the inspections signed and dated by the Quality Assurance Inspector shall be provided to the Authority and OAR. Prior to any scheduled inspections the Authority and OAR representative shall be notified by the Contractor of any inspection(s) so they may witness.
- B. Hardware Installation
1. Final hardware selected and installation of hardware shall be coordinated with the Technical Project Manager. Additionally, the Contractor shall ensure the ventilation requirements for the all hardware components are met.
 2. The Contractor shall install and inspect all hardware required in this specification in accordance with the manufacturer's installation instructions. Final placement of hardware is subject to the Authority and OAR approval.
 3. The Contractor shall be responsible for any and all loss or damage in the shipment and delivery of all material until transfer of title to the Authority.
 4. The Contractor shall obtain written permission from the Authority and OAR before proceeding with any work which requires cutting into or through any part of the building structures such as, but not limited to, girders, beams, concrete, carpeted or tiled floors, partitions or ceilings. The Contractor shall obtain written permission from the Authority and OAR before cutting into or through any part of the building structures where fireproofing or moisture proofing could be impaired. In any such case the Contractor shall be responsible for restoring the affected area to "like-new" condition or to a condition to match the existing conditions.
 5. The Contractor shall take all steps necessary to ensure that all public areas remain clear or are properly marked during installation or maintenance.
 6. The Contractor shall coordinate installation with the Authority and OAR, to minimize disruption of existing business functions at the airport.
 7. The Contractor shall place materials only in those locations that have been previously approved. Any other locations shall be approved, in writing, by the Authority and OAR.
 8. The Contractor shall label all cabling and patch cords in accordance with the Authority approved labeling plan. Coordination with the Authority and OAR shall be performed, and all labeling shall be approved, prior to implementation.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

C. System Startup

1. Subject to the responsibility matrix on the Contract Drawings, the Contractor shall not apply power to the system until after:
 - a. System and components have been installed and inspected in accordance with the manufacturer's installation instructions.
 - b. A visual inspection of the system components has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.
 - c. System wiring has been tested and verified as correctly connected as indicated.
 - d. All system grounding and transient protection systems have been verified as properly installed and connected, as indicated.
 - e. Power supplies to be connected to the system and equipment have been verified as the correct voltage, phasing, and frequency as indicated.
 - f. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installations, defective equipment items, or collateral damage due to Contractor work/equipment.

3.5 COMMUNICATIONS CABLING REQUIREMENTS

- A. All wiring and cables shall be properly dressed and/or bundled with hook-and-loop (Velcro) straps or cable ties. Twisted wire, tape, rope, twine, phone wire and similar bits of debris usually available on site are not acceptable substitutes for proper securing hardware. All inter-rack cables and wiring must be properly routed, and where available, in cable trays. Overhead cables must be easily removed or reworked within the cable trays. Proper care must be taken to ensure that new cables added to the trays are not stressed or intertwined with existing cables. Cables shall not be broken out of their outer jackets except within enclosures designed to support and protect cable break-outs. Overhead cables may not cross perpendiculars or be suspended in mid-air without supports.
 1. Cables exiting conduits at a height exceeding 18" above cable tray shall be supported by conduit waterfall fittings. Cables shall not exit conduits at a height exceeding 3 feet above the supporting cable tray.
- B. Cabling shall be sized to support the appropriate communication system. All communications cable installations shall be in accordance with good engineering practices as established by the ANSI/TIA, IEEE and the NEC and all referenced standards. All cabling shall meet all state and local electrical codes. All cabling shall test free from all grounds, shorts, and EMI.
 1. Contractors shall have the option to combine all cable home runs and conductors of same type and voltage "class" in accordance with NEC requirements unless specified elsewhere. Size all conduits and cable trays to meet the required fill ratios and install all conductors in accordance with NEC requirements, referenced standards and manufacturers recommendations.
 - a. All communications cabling located above accessible suspended ceilings shall be installed in conduit.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- b. Cabling installed above hard ceiling spaces shall be installed in dedicated conduits.
 - c. No exposed cabling will be acceptable in finished or occupied spaces of the facility without approval by the Authority and OAR.
 - d. Any communications system cabling installed exterior to the building and/or all cabling being routed from the facility to any remote location external to the project location shall utilize OSP rated fiber optic cable installed in conduit system.
2. Do not install bruised, kinked, scored, deformed, abraded, or otherwise damaged cable. Do not splice cable between indicated terminations, taps, or junction points. Remove and discard cable where damaged during installation and replace it with new cable.
 3. Ensure that all communications cabling supports (conduits, support grips, cable trays, and cable termination panels) are fully installed before proceeding with cable installation.
 4. At no time shall any cables be installed and left unsupported, nor shall cables be tie-wrapped to any other supporting structure in lieu of specified cable supports. Do not tie-wrap or permanently affix cable bundles to approved cable supports.
 - a. NOTE: Cable bundles shall not be cinched too tightly; all cable ties shall be hook-and-loop ("Velcro") strips only.
 5. The Contractor shall not permit any communications cabling to lie unprotected on the floor at any time. If cables must be left on any floor, protect the cables so that they may not be walked on or have any material or equipment placed or rolled on top. Replace all damaged cables from demarcation to termination point; no splicing of damaged cables shall be permitted.
 6. Maintain manufacturers recommended minimum bend radiuses of all cabling. Where referenced standards stipulate a larger bend radius than that specified by the manufacturer, comply with the larger requirement. Do not stretch, stress, tightly coil, bend, or crimp cables. The Contractor shall keep all cabling out of the way of other trades during staging of any work. The contractor at the contractor's expense will replace all severely stressed or damaged cables, equipment, and materials as determined by the Authority and OAR.
 7. Do not exceed the manufacturer's maximum specified pull tension during installation. Where the manufacturer does not specify a maximum pull tension, follow those specified in the applicable referenced standard(s). Contractor shall utilize a winch with tension control or a "break-away" link designed to break away at or below the recommended maximum pulling tension.
 8. Special care shall be taken to avoid damage to the cable. While under pulling tension, the cable shall not be bent into a curve with a radius of less than twenty (20) times the cable diameter, or no less than manufacturers minimum.
 9. Use methods and lubricating compounds on cables and wires to prevent damage to material and products during roughing-in. Provide compounds that are not injurious to the cable and wire jackets that do not harden or become adhesive.
 10. No media, fiber or copper, shall be installed in lengths surpassing Standards based length requirements.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

11. Wire and cable routing shown on the Contract Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project conditions.
 12. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required. Record actual routing on as-built for all conduit larger than one inch.
 13. Cables shall not be broken out of their jackets except within enclosures designed to support and protect cable breakouts, splices, and/or terminations.
 14. Installation of all cabling shall be in accordance with all guidelines established by the product manufacturer and all referenced industry standards.
- C. Unshielded Twisted Pair (UTP) and Shielded Twisted Pair (STP) Cable
1. All TCP/IP-based copper network cabling shall be Category 6 or Category 6a rated as noted and installed in conduit except within dedicated communications rooms. All communications raceway shall not contain any AC carrying conductors or non-associated communications network cables.
 2. Refer to related specification sections for additional requirements related to Category 6 or 6a cabling types, and testing requirements.
 - a. All network cabling located above accessible suspended shall be installed in dedicated conduits, exposed cabling supported by the use of "J" hooks shall not be accepted.
 - b. All horizontal data drops shall be terminated on Category-6 or 6a patch panels installed on the 19" equipment racks\cabinets.
 - c. All data drops and backbone cabling installed above inaccessible ceiling spaces or areas containing no ceiling shall be installed in dedicated conduits. In no case shall cable be supported on ceiling tiles, T-bars, or tie- wrapped to any conduit or pipes.
 - a) Category-6 or 6A cables shall not be cinched too tightly; all cable bundles at patch panel locations and in the field shall be VELCRO type strips only. Plastic wire ties shall not be accepted on any Category-6 or 6a cabling.
 - b) Each horizontal cabling drop shall be a dedicated Category-6 or 6a cable and shall not exceed a maximum cable length of 295 feet (including slack and service loops)..
 - c) Communications drops installed inside walls shall be installed in dedicated conduit terminating in a junction box at the jack location.
 - d) Cable and wiring shall not lay loose on ceiling tiles or grids. Cable must be supported in all areas. Bridle rings or tie-wrapped supporting methods are not acceptable. Conduit stub-ups shall extend to the cable tray.
 - e) Install all cabling parallel and perpendicular to building lines and follow building structure. Use cable support equipment/hardware recommended by the manufacturer and/or as herein specified.
 - f) Provide all terminations, cross-connects, wire management, surge protectors, etc. for a complete and operational system.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

2. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers published torque-tightening values for equipment connectors.
 3. Rack and terminal cabinet wiring shall be neatly routed or bundled and routed along rack sides. All splices and connections shall be by plug, solder or screw terminal strips, etc. Splices shall not hang in racks or terminal cabinets.
- G. Conduits/Raceway/Cable Trays
1. Provide conduit and raceway systems for all communications networks as indicated below. Refer to all related specification sections for additional conduit and raceway information.
 - a. Exposed structure: Provide conduit run from each drop to the nearest communication room.
 - b. Vertical cabling shall be installed in dedicated conduits and shall be supported between floors in closets or accessible locations; in no case shall any cable risers be unsupported.
 - c. Cables entering all communications equipment rooms shall be supported with Cable tray from entrance to rack/cabinet location as indicated on the contract drawings and/or herein specified.
 - d. Wire basket cable tray system shall be provided in all corridors as indicated on the contract drawings and installed as herein specified.
 2. All conduits/raceways shall be concealed and shall be installed above accessible finished ceilings and/or in walls. Any conduits/raceways installed in areas requiring installation to be exposed, shall be installed as tight as possible to ceilings and at right angles to walls/building lines and shall not obstruct any access hatches, equipment service panels, lighting or other equipment and/or devices. No exposed conduits/raceways shall be installed without prior approval of the Authority and OAR.
 - a. Where conduits cannot be concealed above ceilings or in walls and must be installed in finished or public areas of the building, all conduits shall be finished wire-mold type raceways or approved equal. Finished wire-mold type raceways shall not be installed without prior approval in writing by the Authority and OAR.
 - b. Where any equipment and/or junction boxes are installed above non-accessible finished ceilings, the contractor shall provide access hatches listed for the intended application. Access hatches shall be located so that service access to the equipment and/or junction boxes is unimpeded.
 - 1) Access hatches shall not obstruct any equipment, service panels, lighting equipment, devices, or any architectural elements of the ceiling. At the time of submittals, the contractor shall submit all proposed access hatch locations for review by the Design Professional.
 - c. All conduits/raceways shall be supported in accordance with NEC requirements and referenced standards.
 - d. All conduits/raceways shall be installed in a manner that prevents tampering or removal when installed in areas exposed to the general population.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- 1) Provide tamper-resistant installation utilizing “torx with peg” security-fastening devices for all conduits/raceways, equipment, devices and appurtenances in all areas accessible to the general population and/or areas subjected to tampering or vandalism.
- e. Interior raceways shall be a minimum 1 inch unless otherwise noted. Exterior raceways shall be a minimum 1 1/4-inch. Size all raceways and install conductors in accordance with NEC requirements. Fill ratio shall not exceed 40 percent for indoor raceways or exterior raceways.
 - 1) EMT conduit with compression fittings may be utilized in all inaccessible ceiling areas unless otherwise restricted by code.
 - 2) Threaded Rigid metal conduit shall be used on all exterior applications, stub-ups and all interior areas where concealed conduit requirements cannot be met and are exposed to tampering or damage by the general population.
 - a) All areas considered being of high risk due to the nature of the occupancy or the need to protect and maintain the integrity of the cabling shall be installed in rigid threaded conduits.
- f. Conduit expansion couplings shall be furnished and installed in all areas where expansion/contraction of structure may occur in order to couple two sections of a conduit runs to support longitudinal movement. The contractor shall refer to architectural drawings for exact locations of all building expansion joints.
 - 1) Conduit expansion couplings shall be consistent with the size the conduit being installed, shall be steel electrogalvanized, and shall meet all environmental and seismic conditions.
 - 2) Expansion couplings shall be weatherproof and approved for use indoors or outdoors without an external bonding jumper.
 - 3) Expansion couplings shall be UL Listed and approved for use in wet locations.
 - 4) Expansion couplings shall comply with UL 514B, CSA 22.2 No. 18 3-12, NEMA FB1.
- g. Exterior raceways: PVC schedule 40 conduit at the minimum shall be utilized in all underground applications unless otherwise specified by related specification sections. The conduit shall be buried at a minimum 36” below grade. Warning flagging tape shall be buried 12” below grade to indicate the conduit routing location. Refer to related specification sections for additional requirements.
 - 1) All exterior conduits larger than 2” in diameter shall be provided with dedicated inner-duct conduit systems, segregated by network type (i.e. security, etc.) and shall include a minimum of one spare empty inner-duct per conduit at the completion of the project.
 - 2) The Contractor shall have the option to utilize the same trench/routing location as other utilities. In no case shall any system conduits or duct banks be combined with other electrical utilities without providing the required separation between conduits as necessary to ensure the minimal transmission or conduction of any RF and/or EMI signals.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- h. Outlet Boxes: shall be 4-11/16 x 4-11/16 x 2-1/8 inches deep with single gang reducer plate where required for all data outlet locations and single gang for wall mounted telephone locations.
 - 1) All outlet boxes shall be provided with single or dual gang device mud-rings flush to finished wall as required based on type and configuration of outlet and type of wall construction.
 - 2) Use deep masonry boxes at masonry construction. T-Bar hangers or other appropriate mounting hardware shall be utilized to support boxes mounted in the ceiling.
- 3. Cable Tray – Ladder Type: Provide a two-tier cable tray system in all communications rooms and closets for routing horizontal distribution and backbone communications cables as detailed on the Contract Drawings. Refer to Specification Section 27 10 00 for Cable Tray specifications and additional requirements. Cable tray shall be complete will all materials, miscellaneous hardware and all appurtenances required for a complete cable distribution and support system. All cable trays shall be furnished with swept bends/corners within telecommunications room (IDF/MDF) spaces. Provide drop-out/waterfall fittings above racks/cabinets.
 - a. All cable tray widths shall be sized according to the total number of cables to be supported within the various trays plus an additional 100% spare capacity for future expansion capability.
 - b. Install cable tray in a manner ensuring that all cables fully comply with all ANSI/TIA standards.
 - 1) Maintain a minimum clearance of 24” between top of uppermost cable tray and ceiling structure or other equipment or raceway.
 - 2) Maintain a minimum clearance of 12” between bottom of cable tray and top ceiling grid or other equipment or raceway. Maintain 12” of clearance between upper and lower cable tray tiers.
 - 3) Maintain a minimum clearance of 24” from all conduits or cables used for electrical power distribution.
 - 4) Maintain a minimum clearance of 12” between bottom of lower cable tray and top of equipment racks and/or cabinets
 - 5) Maintain a minimum clearance of 24” from fluorescent lighting. All Pathways shall cross perpendicular to fluorescent lighting and electrical power cables or conduits.
 - 6) Cable tray supports shall be attached to the structural ceiling or walls with hardware or other installation and support aids specifically designed for the cable tray and designed to support the cable tray’s weight and required cable weight and volume.
 - 7) Do not attach cable tray supports to ceiling support system or other mechanical support systems.
 - 8) Cable tray installed adjacent to walls shall be supported from the wall using brackets.
 - 9) Do not support cable trays from cabinets or racks. Connections between cable tray and cabinets or racks shall be for the purposes of stabilization only.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- 10) Load span criteria: Install tray supports in accordance with the load criteria of L/240, with minimum 5/8" threaded rod for ceiling support within telecommunications spaces.
 - 11) Cable Trays shall be supported in accordance with manufacturers' published recommendations, or at a maximum of 6-foot intervals, whichever is lesser in spacing, and within 2 feet of each end.
 - 12) All Cable trays shall be installed without burrs, sharp edges, or projections, which may damage cable insulation.
 - 13) All lengths or sections of cable tray shall be bonded and grounded in accordance with NEC, ANSI/TIA, IEEE.
- c. Follow manufacturers' instructions for installing, components and adjusting all equipment and cabling. Submit two (2) copies of such instructions to the Architect before installing any equipment. Provide a copy of such instructions at the equipment during any work on the equipment. Where no instructions are included with the equipment, follow accepted industry practices and workmanlike installation standards.
 - d. Acceptable Manufacturers: Subject to compliance with these specifications, ladder tray shall be as manufactured by:
 - 1) Chatsworth (CPI)
 - 2) Homaco
 - 3) Eaton B-Line
 - 4) Or approved equal.
4. Cable Tray - Basket Type
- a. Acceptable Manufacturers: subject to compliance with these specifications, wire cable trays and support systems as manufactured by:
 - 1) Chatsworth (CPI)
 - 2) Legrand
 - 3) EatonB – Line Systems
 - b. General
 - 1) Provide wire cable tray where indicated by the contract documents; the contractor shall include all required types, sizes, necessary connector assemblies, clamp assemblies, connector plates, splice plates and splice bars. Construct units with rounded edges and smooth surfaces; in compliance with applicable standards; and with the following additional construction features.
 - c. Materials and Finishes specifications for each wire cable tray as follows:
 - 1) Electroplated Zinc: Straight sections shall be made from steel meeting the minimum mechanical properties of ASTM A510 and shall be electro-plated zinc in accordance with ASTM B633 SC2.
 - 2) Stainless Steel: Straight sections and accessories shall be made from AISI Type 304 Stainless Steel.
 - 3) Paint: Straight sections shall be painted "Computer White" over Electrodeposited Zinc.
 - 4) Pre-Galvanized Zinc: Wall brackets and other pre-galvanized accessories shall be coated with zinc in accordance with ASTM A653.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- 5) Electro-Galvanized Zinc: Support accessories and miscellaneous hardware shall be coated in accordance with ASTM B633 SC3. All threaded components shall be coated in accordance with ASTM B633
 - 6) All straight section longitudinal wires shall be straight (with no bends).
 - 7) Wire cable tray shall be made of high strength steel wires and formed into standard 2 inch by 4-inch wire mesh pattern with intersecting wires welded together. All wire ends along wire cable tray sides (flanges) shall be rounded during manufacturing for safety of cables and installers.
 - 8) Wire cable tray sizes shall conform to the following nominal criteria:
 - a) Straight sections shall be furnished in standard 120-inch lengths.
 - 9) Wire basket shall have at the minimum 4-inch usable loading depth by 16 inches wide.
- d. Cable Tray Support System
- 1) All fittings shall be field formed as needed.
 - 2) All splicing assemblies shall be the bolted type using serrated flange locknuts. Hardware shall be either yellow zinc dichromate in accordance with ASTM B633 SC2 or AISI Type 304 Stainless Steel.
 - 3) Wire basket supports shall be center support hangers, trapeze hangers or wall brackets as manufactured by Cooper B-Line, Inc. or Architect approved equal.
 - 4) Trapeze hangers or center support hangers shall be supported by 1/4 inch or 3/8-inch diameter rods.
 - 5) Special accessories shall be furnished as required to protect, support, and install a wire basket support system.
- e. Installation
- 1) Install wire cable tray where indicated on the contract drawings in accordance with manufacturers requirements and recognized industry practices (NEMA VE-2 2000). Ensure that the cable tray equipment complies with requirements of NEC, and applicable portions of NFPA 70 and NECA's "Standards of Installation" pertaining to general Electrical installation practices.
 - 2) Coordinate wire cable tray with other electrical work as necessary to properly interface installation of cable tray with other trades.
 - 3) Provide sufficient space encompassing cable tray to permit access for installing and maintaining cables. Provide a minimum clearance of at least 6" clear AFC and 12" clear above cable tray.
 - 4) Basket type cable tray shall be installed so as to be electrically continuous, but under no circumstances shall cable tray be configured for use as an electrical bonding conductor.

H. Penetrations of Walls and Floors:

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

1. All wall/floor penetrations are to be sleeved and fire stopped with approved fire stopping material or sealant as applicable for the type of penetration. Coordinate all cable and conduit penetrations of building with all affected trades. Refer to all related specification sections for additional wall/floor penetration requirements.
 - a. All penetrations of rated walls and floors shall be fire stopped in accordance with the ASTM and NFPA standards. Refer to related specification sections for additional requirements.
 - b. Floor penetrations shall be sleeved with a minimum sleeve diameter of 4 inches. An additional penetration shall be provided for future use, sleeved, and capped and fire stopped as required.
 - c. Coordinate size of wall penetration with conduit size, number of conductors. Comply with all NEC requirements.
 - d. The fire rating of all penetrated walls, floors, and ceiling structures shall be strictly maintained. All penetrations shall be fire-stopped and sealed by the Contractor.
 - e. Install fire-stopping in open penetrations and in the annular space of penetrations for fire rated barriers.
 - f. Installation of fire-stops shall be performed by an applicator/installer qualified and trained by the manufacturer. Installation shall be performed in strict accordance with manufacturer's detailed installation procedures.
 - g. Installation of all fire-stopping shall be in accordance with fire test reports, fire resistance requirements, acceptable sample installations, manufacturer's recommendations, local fire and building authorities, and applicable codes and shall be installed in a manner acceptable to the authority having jurisdiction.

3.6 ELECTRICAL POWER DISTRIBUTION

- A. Refer to Division 26 specifications in addition to the following:
 1. Primary power for all system controls, sub-control panels, processors, and power supplies shall be configured to switch to emergency backup power sources automatically when primary power is interrupted without degradation of any critical system functions.
 2. All electrical power shall be hardwired to the panel. System components or panels employing the use of plug-in transformers, extension cords or cheater cords for the connection to electrical power shall not be acceptable.

3.7 TRANSIENT VOLTAGE SUPPRESSION

- A. Transient Voltage Surge Suppression: All cables and conductors extending beyond building façade (except nonconductive fiber optic cables) which serve as communications, control, or signaling circuits shall be protected against Transient Voltage surges and have Transient Voltage Surge Suppression (TVSS) protection.
 1. The TVSS device shall be UL listed in accordance with Standard TIA 497B installed at each end. Lighting and surge suppression shall be a multi-strike variety and include a fault indicator.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

2. Protection shall be furnished at the equipment and additional triple solid state surge protectors rated for the application on each wire line circuit shall be installed within 914.4 mm (3 ft) of the building cable entrance. Fuses shall not be acceptable for surge protection applications. All inputs and outputs shall be tested in both normal mode and common mode to verify there is no interference at the minimum surge suppression test shall meet the following criteria.
 - a. All system power supplies serving exterior system components or devices shall be provided with the appropriate transient surge suppression protection on both the line side as well as the load side.
 - 1) A 10-microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes shall be the minimum performance requirements. Provide surge suppression in accordance with all manufacturers requirements.
 - 2) An 8-microsecond rise time by 20-microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes shall be the minimum performance requirements. Provide surge suppression in accordance with all manufacturers requirements.
 - 3) Maximum series current: 2 AMPS. Provide units manufactured by Advanced Protection Technologies, model # TE/FA 10B or TE/FA 20B or approved equal.
 - 4) Operating Temperature and Humidity: -40 to 85 degrees C (-40 to 185 degrees) shall be the minimum performance requirements. Provide surge suppression in accordance with all manufacturers requirements.

3.8 GROUNDING AND BONDING

- A. All electronic equipment, conduits, cable trays, racks/cabinets and cable shields shall be properly grounded and bonded in accordance with all requirements of ANSI/TIA 607-C, NEC 250 and IEEE 1100. Additionally, all communications space, IDF, and MDF room grounding and bonding shall be in accordance with all related specification sections and Motorola R56 Standards and Guidelines for Communications Sites (where Motorola radio equipment is installed).
- B. A Telecommunications Grounding System shall be installed in all communications equipment rooms. Grounding system shall provide equalization of the grounding potentials between the building power system and the telecommunications main grounding bus-bar (TMGB) as well as all telecommunications grounding bus-bars (TGB).
 1. Telecommunications Main Grounding Busbar
 - a. The TMGB shall serve as the dedicated extension of the building grounding electrode system for the telecommunications infrastructure as well as the central attachment point for all TGBs. The TMGB shall be located and provided in the Main Telecommunications Room (MDF) in each building. The TMGB shall be listed by a nationally recognized testing laboratory (NRTL).

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- b. The TMGB shall, at a minimum, meet the following requirements:
- 1) Material: Copper or copper alloys having a minimum of 95% conductivity when annealed as specified by the International Annealed Copper Standard (IACS).
 - 2) Thickness: minimum ¼" thick
 - 3) Width: No less than 4"
 - 4) Length: The length of the TMGB shall vary based on the installation requirements. The Contractor shall ensure the length of the bar is sufficient to include enough pre-drilled holes for all necessary bonding conductors. The bar shall be no less than 14" long. The minimum number of pre-drilled holes required in the TMGB shall include, but not be limited to the following:
 - a) Two holes for the Telecommunications Bonding Conductor (TBC) termination.
 - b) Two holes for each Telecommunications Bonding Backbone (TBB) termination.
 - c) Two holes for the Alternating Current Equipment Ground (ACEG) termination.
 - d) Two holes for each Telecommunications Equipment Bonding Conductor (TEBC) in the room.
 - e) Two holes for each protector block in the room.
 - f) Two holes for each ladder tray, or independent section thereof in the room. Each independent section of ladder tray must be independently bonded to the TMGB in a manner consistent with referenced standards. Bonding one tray through another that is directly bonded to the TMGB (serial bonding) is prohibited.
 - g) Two holes for each set of conduit sleeves or metallic communications pathways entering the room.
 - h) Two holes for each bonding conductor to structural steel (as required).
 - i) 20% of spare capacity shall be available after all terminations are done and the project is complete.
 - j) If quantity of holes exceeds the maximum available by a manufacturer, multiple bars shall be provided as to match the criteria indicated above.
 - k) Pre-drilled holes: Shall be configured for use with correctly matched listed lugs and hardware. All pre-drilled holes shall have a minimum diameter of 5/16"
 - l) Hole spacing: All pre-drilled holes shall have a minimum spacing of 5/8"
 - 5) The TMGB shall be installed on the wall with stand offs and isolators. Isolators shall be rated at 600V.
 - 6) Only one lug shall be installed per hole mounting pair on a bonding surface. Lugs shall not overlap or use the same mounting holes on a bonding surface.
 - 7) Basis of design: Harger GBI144xxTMGB or approved equal.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

2. Telecommunications Grounding Busbar
 - a. The TGB shall serve as the bonding connection point for the Telecommunications systems and equipment in the area served by a Communications Room (IDF). The TGB shall be located and provided in each Telecommunications Room (except the main telecommunications room) in each building and any other locations indicated on the drawings. The TGB shall be listed by a nationally recognized testing laboratory (NRTL).
 - b. The TMGB shall, at a minimum, meet the following requirements:
 - 1) Material: Copper or copper alloys having a minimum of 95% conductivity when annealed as specified by the International Annealed Copper Standard (IACS).
 - 2) Thickness: minimum ¼" thick
 - 3) Width: Minimum 2"
 - 4) Length: The length of the TGB shall vary based on the installation requirements. The Contractor shall ensure the length of the bar is sufficient to include enough pre-drilled holes for all necessary bonding conductors. The bar shall be no less than 12" long. The minimum number of pre-drilled holes required in the TGB shall include, but not be limited to the following:
 - a) Two holes for the Telecommunications Bonding Backbone (TBB) termination.
 - b) Two holes for the Alternating Current Equipment Ground (ACEG) termination.
 - c) Two holes for each Telecommunications Equipment Bonding Conductor (TEBC) in the room.
 - d) Two holes for each protector block in the room.
 - e) Two holes for each ladder tray, or independent section thereof in the room. Each independent section of ladder tray must be independently bonded to the TMGB in a manner consistent with referenced standards. Bonding one tray through another that is directly bonded to the TMGB (serial bonding) is prohibited.
 - f) Two holes for each set of conduit sleeves or metallic communications pathways entering the room.
 - g) Two holes for each bonding conductor to structural steel (as required).
 - h) 20% of spare capacity shall be available after all terminations are done and the project is complete.
 - i) If quantity of holes exceeds the maximum available by a manufacturer, multiple bars shall be provided as to match the criteria indicated above.
 - 5) Pre-drilled holes: Shall be configured for use with correctly matched listed lugs and hardware. All pre-drilled holes shall have a minimum diameter of 5/16"
 - 6) Hole spacing: All pre-drilled holes shall have a minimum spacing of 5/8"

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- c. The TGB shall be installed on the wall with stand offs and isolators. Isolators shall be rated at 600V.
 - d. Only one lug shall be installed per a two-hole mounting on a bonding surface. Lugs shall not overlap or use the same mounting holes on a bonding surface.
 - e. Basis of Design: Harger GBI142xxTGB or approved equal
3. Telecommunications Bonding Conductors
- a. Telecommunications Bonding Conductors referenced in this section are not intended to be comprehensive. Reference ANSI/TIA-607 for more information on all telecommunications bonding requirements.
 - b. Ferrous metallic conduits containing bonding conductors for telecommunications shall be bonded, at each end of the conduit, directly to the bonding conductor, using a listed exothermic weld, listed irreversible compression-type connectors, or approved equivalent, or to the TMGB/TGB, using a grounding bushing and a minimum 6 AWG bonding conductor. The bonding conductor contained within the ferrous metal conduit shall not be twisted around and passed through the grounding lug on the ground bushing to bond the conduit.
 - c. The minimum included bend angle for all bonding conductors shall be 90°.
 - d. Bends of bonding conductors terminating at the TMGB or TGBs shall have a minimum inside bend radius of 8 inches.
 - e. Bends of bonding conductors at all other locations shall be made with the greatest practical inside bend radius. The minimum bend radius of all bonding conductors other than those at the TMGB and TGB shall be 10 times the bonding conductor diameter.
 - f. Telecommunications Bonding Backbone (TBB)
 - 1) The TBB is a conductor that interconnects all TGBs with the TMGB. The intended function of a TBB is to reduce or equalize potential differences. The TBB originates at the TMGB, extends throughout the building using the telecommunications backbone pathways, and connects to the TGBs in Telecommunications Rooms.
 - 2) The minimum TBB conductor size shall be a 6 AWG. The TBB shall be sized at 2 kcmil per linear foot of conductor length up to a maximum size of 750 kcmil. Refer to ANSI/TIA-607 for more information.
 - 3) All TBBs shall:
 - a) Be protected from physical and mechanical damage
 - b) Originate from the TMGB
 - c) Follow the backbone pathways
 - d) Be continuous from the TMGB to the furthest TGB to which it is connected. Daisy-chaining from busbar to busbar is prohibited.
 - e) Minimize to the extent practical the length of the conductor
 - f) Be installed without splices
4. Telecommunications Equipment Bonding Conductor (TEBC)
- a. The TEBC connects the TMGB/TGB to equipment racks/cabinets.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- b. More than one TEBC may be installed from the TMGB/TGB.
 - c. The TEBC shall be a continuous copper conductor that is sized not less than a 6 AWG or as the largest size equipment grounding conductor in the ac branch power circuit(s) serving the racks/cabinet lineup.
 - d. Connections to the TEBC shall be made with listed irreversible compression connectors, suitable for multiple conductors, and with all bends from racks and cabinets routed toward the TMGB/TGB.
 - e. TEBCs shall not be routed within or on top of ladder trays or close to other cables
 - f. Maintain minimum required separation from other cable groups per NEC and referenced standards.
 - g. The TEBC shall be connected to the cabinets/equipment racks, to a Rack Bonding Conductor (RBC) or to a vertical/horizontal Rack Bonding Busbar (RBB). Each cabinet or equipment rack shall have a suitable connection point to which the bonding conductor can be terminated.
5. The TMGB and each TGB shall be provided where indicated on the drawings and shall provide an effective bonding connection to the nearest approved building grounding electrode (e.g., structural steel) as well as to the local power distribution panel grounding system (e.g., ac branch circuit panel board's equipment grounding busbar).
- a. Equipment Grounding: Metallic structures, equipment racks, cabinets and enclosures as well as all raceways, cable trays, junction boxes, outlet boxes, machine frames, and other conductive items shall be bonded and grounded.
 - b. Cabinets, racks, and other enclosures shall not be bonded serially; each shall have their own dedicated bonding conductor to the TMGB/TGB or TEBC.
 - c. Equipment containing metallic parts and patch panels for shielded cabling in cabinets and racks shall be bonded to the telecommunications bonding system in accordance with the manufacturer instructions.
 - 1) Where instructions are not given, all bonding conductors that connect these installed products shall be a minimum sized conductor of 12 AWG.
 - d. Cabinets and racks including an isolated RBB will require a separate minimum 6 AWG bonding conductor, from both the cabinet/rack and the RBB, back to the TMGB/TGB or TEBC.
 - e. Duct Banks and Manholes: Provide an insulated equipment grounding conductor in each duct containing any voltage conductors, sized per NEC except that minimum size shall be No. 2 AWG. Bond the equipment grounding conductors to the grounding bus, to all manhole hardware and ground rods, to the cable shielding grounding provisions for all cable splices, terminations and equipment enclosures.
 - f. Metallic Fences equipped with communications equipment: Fences shall be grounded with a ground rod at each fixed gate post and at each corner post.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- 1) Drive ground rods until the top is 300 mm (12 inches) below grade. Attach a No. 4 AWG copper conductor, by exothermic weld to the ground rods and extend underground to the immediate vicinity of fence post. Lace the conductor vertically into 300 mm (12 inches) of fence mesh and fasten by two approved bronze compression fittings, one to bond wire to post and the other to bond wire to fence.
 - 2) Each gate section shall be bonded to its gatepost by a 3 by 25 mm (1/8 by one inch) flexible braided copper strap and ground post clamps. Clamps shall be of the anti- electrolysis type.
6. All connections of grounding conductors to ground rods, bus bars, rebar, structural members, pipes and fences, as well as splices of any ground conductors, shall be made by exothermic welds except where otherwise noted. All connections to bar lugs shall be exothermic weld or compression type connections. Bolted type connection of ground conductors may only be made where terminal lugs or blocks have been furnished and installed in equipment by the manufacturer.
- a. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes No. 4 AWG and larger shall be permitted to be identified per the NEC.
7. Refer to related specification sections for any additional grounding and bonding requirements.

3.9 EQUIPMENT IDENTIFICATION

- A. Identify all system control, component and equipment cabinets and racks using plastic laminate engraved ("lamicoid") labels, or approved equal. Firmly affix to the panel, device, and/or component. Refer to Specification Section 27 10 00, Attachments and all related specification sections for additional requirements.
- B. Permanently label all horizontal and backbone cabling, conduit, pathways, pullboxes, junction boxes and enclosures in accordance with Specification Section 27 10 00 and Attachments.
 1. Warning Tags: At each location where the fiber cable is exposed to human intrusion, it shall be marked with warning tags. These tags shall be yellow or orange in color, and shall contain the warning: "CAUTION FIBER OPTIC CABLE." The text shall be permanent, black, block characters, and at least 3/16" high.
 - a) A warning tag shall be permanently affixed to each exposed cable or bundle of cables, at intervals of not more than five (5) feet. Any section of exposed cable which is less than five (5) feet in length shall have at least one warning tag affixed to it.
 2. Provide typewritten circuit directories installed in 3-ring binders with transparent page protectors in each control and sub control cabinet and/or equipment rack.

3.10 MAINTENANCE & SERVICE

- A. General Requirements

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

1. The Contractor shall provide all services required and equipment necessary to maintain all contractor-furnished communications systems associated with this project during the Warranty period.
 - a. Provide all necessary material required for performing scheduled adjustments or other non-scheduled work. Impacts on facility operations shall be minimized when performing scheduled adjustments or other non-scheduled work. Refer to Division 01 specification section for additional requirements.
 - b. The adjustment and repair of the communications systems shall include all software and firmware updates on all computers, servers, CPUs, terminals, devices, communications and data transmission media (DTM), facility interface processors, signal transmission equipment and processors.
 - c. Test, inspect, and service each system on a quarterly basis (three month intervals) during the warranty period from the time of final acceptance. The contractor shall compare quarterly test results with the test results at the time of final acceptance.
 - 1) The contractor shall include as part of the quarterly test the calibration and/or adjustment of any device, component, and/or system that has deviated from the original test results at the time of final acceptance.
 - d. For each quarterly maintenance period, provide written notification to the Authority and OAR of the systems condition before and after service, the exact components that were tested and serviced, and overall status of the system.
- B. Personnel
 1. Service personnel shall be manufacturer certified in the maintenance, testing, and repair of the type of system and equipment provided for the project. Provide the Authority and OAR the name of the designated service representative, and of any change in personnel.
 - a. The Authority and OAR shall be provided copies of system manufacturer certifications for all designated service representatives.
 2. Schedule of all work to be performed during regular working hours, Monday through Friday, excluding federal holidays.
- C. Emergency Service
 1. The Authority shall initiate service calls whenever the system is not functioning properly. The Contractor shall provide the Authority with an emergency service center telephone number. The emergency service center shall be staffed 24 hours a day 365 days a year. The Authority shall have sole authority for determining catastrophic and non-catastrophic system failures.
 - a. For catastrophic system failures, the Contractor shall provide same day eight (8) hour service response with a defect correction time not to exceed sixteen (16) hours from arrival on site. Catastrophic system failures are defined as any system failure that the Authority determines will place the facility(s) at increased risk.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- b. For non-catastrophic failures, the Contractor within 1 business day with a defect correction time not to exceed 48 hours from time of notification.

D. Records & Logs

- 1. The Contractor shall maintain records and logs of each task and organize cumulative records for each component and for the complete system chronologically. A continuous log shall be submitted for all devices. The log shall contain all initial settings, calibration, repair, and programming data. Complete logs shall be maintained and available for inspection on site, demonstrating planned and systematic adjustments and repairs have been accomplished for the system.

E. Work Request

- 1. The Contractor shall separately record each service call request, as received. The record shall include the serial number identifying the component involved, its location, date and time the call was received, specific nature of trouble, names of service personnel assigned to the task, instructions describing the action taken, the amount and nature of the materials used, and the date and time of commencement and completion.
- 2. The Contractor shall deliver a record of the work performed within five (5) working days after the work was completed.

F. System Modifications

- 1. The Contractor shall make any recommendations for system modification in writing to the Authority and OAR. No system modifications, including operating parameters and control settings, shall be made without prior written approval from the Authority. Any modifications made to the system shall be incorporated into the operation and maintenance manuals and all related documentation.

3.11 WARRANTY

- A. Warrant material and workmanship for a period of at least one (1) year. Warranty period shall be longer if specified in related specification sections, or if provided by the furnished product's manufacturer. The warranty period shall commence from the date the Contractor received written notification of final acceptance from the Authority and/or OAR. At the minimum the contractor shall provide warranty provisions:
 - 1. Warrant the replacement of defective components/materials and/or correct defective work when given notice by the Authority and OAR during the warranty period.
 - a. At no time is the contractor to use the extra materials provided under the scope of this project to replace malfunctioning or damaged equipment and or components. The Contractor shall replace all malfunctioning or damaged equipment and or components with new. The repair and then reinstallation of malfunctioning or damaged equipment shall not be acceptable.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- b. During the Warranty period, replace failed equipment per the terms specified in this section. As such, the Authority and OAR shall not be bound to the terms and conditions of the manufacturer's warranty, pertaining to the replacement of failed equipment. In any situation, it is the Vendor's responsibility to keep the system operational during any hardware or software failures. Replacement equipment shall be provided to maintain operations while equipment manufacturer addresses warranty issues.
 - 1) Warranty replacements and repairs shall include any necessary shipping, handling and materials.
 - c. Establish a single point of contact for the Authority and OAR and provide any coordination responsibilities with manufacturers, suppliers, or contractors to resolve warranted issues and on all maintenance and service actions related to items included in the Warranty. Process and procedures for engaging technical support shall be developed and communicated to the Authority, OAR, Authority Vendor.
- 2. Warranty excludes liability for consequential incidental, or special damages due to vandalism, misuse, or acts of god.
 - 3. Onsite warranty response time by qualified technician shall be no more than 8 hours upon receipt of request from Authority, unless otherwise noted in related Division 27 and 28 specification sections.
 - 4. Warranty repairs shall be provided to the Authority at no cost. This shall include but not limited to replacement of all defective components/materials, all labor charges, all travel costs and all vehicle charges.
 - 5. Response time shall be 7 days a week / 24 hours a day / 365 days a Year.
 - 6. Provide test, inspection, and service of each system on a semi-annual basis at six month intervals.
 - 7. Contractor must provide verification that they maintain their principle base of operation along with the personnel that will be responsible for providing service within 3 hours driving time to the project site. This tenet of the warranty shall remain in effect for the life of the warranty.
 - 8. All TCP/IP-based communications systems cabling and related appurtenances shall be provided with the manufacturer's 25-year extended warranty in addition to all requirements above.
- B. The Contractor shall, as a condition of final payment, execute a written warranty certifying all contract requirements have been completed in accordance with all requirements of the Contract Documents.
- 1. All system testing, commissioning, demonstration and training shall be performed prior to final system acceptance. All defects or damages due to faulty materials or workmanship shall be replaced without delay, to the satisfaction of the Authority's Representative, at the Contractor's expense.
 - a. The contractor shall provide written documentation of test results and stating what was done to correct any deficiencies. The first inspection shall occur 90 calendar days after the acceptance date. The last inspection shall occur 30 calendar days prior to the end of the warranty.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- b. The warranty period shall be extended until the last inspection and associated corrective actions are complete. Where any equipment and/or labor covered by Contractor's or manufacturer's warranty, has been replaced, due to failure, the warranty period for any replaced equipment or restored work shall be reinstated for a period equal to the original warranty period, and commencing with the date of completion of the replacement or restoration work.
- 2. In the event any manufacturer customarily provides a warranty period greater than one (1) year, the Contractor's warranty shall be for the same duration for that component.
- C. The Technical Project Manager, GOAA OAR and GOAA Information Technology Department retain the right to use additional repair personnel as necessary to correct any warranty trouble calls and back charge the Contractor if the Contractor has been considered non-responsive to repair requests by the Owner.

3.12 SERVICES

- A. In addition to all testing requirements as specified by Division 01 specification section and all related Division 27 and 28 Specification Section, testing of all systems, sub-systems and cabling infrastructures shall be provided in accordance with all requirements of this section.
- B. Notify the Authority and OAR in writing, prior to the closing of any ceilings and ten (10) days advance of testing all system cabling to prevent delays in construction schedules.
- C. Test all cabling to confirm that no grounds, shorts, sneak currents, RFI and EMI conditions exist prior to start-up and commissioning of all, components, devices, equipment and/or systems.
- D. Before requesting a final inspection, the contractor shall perform a series of end to end installation performance tests. The contractor shall submit for approval by the Authority and OAR all test procedures to be employed, test result forms, and timetable for testing all fiber optic and UTP structured copper wiring.

3.13 PROJECT CLOSEOUT REQUIREMENTS

- A. In addition to all final close requirements as specified by Division 01, Specification Section 270500 Specification Section, the Contractor shall comply with all requirements of this Section.
- B. Final System Acceptance
 - 1. In addition to the requirements set forth in Division 01, the Contractor shall prepare and issue a Certificate of Project Completion, containing:
 - a. The date of project completion.
 - b. A list of items that have been corrected by the Contractor.
 - c. The time and date the Authority will assume possession of the system (transfer of ownership).
 - d. The date that warranty begins.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

2. The Authority and OAR will perform an inspection after receipt of written certification. The project completion inspection shall include, but not be limited to:
 - a. The project's contracted work and any additional change orders.
 - b. All equipment and systems tested and shown operational in the presence of the Authority and OAR.
3. After the inspection the Authority and OAR will prepare and submit to the Contractor, a list of items to be completed or corrected, as determined by the inspection, along with the designated timeframe for completion.
4. Should the Authority or OAR consider the work to be incomplete, the Authority or OAR will immediately notify the Contractor, in writing, stating the reasons. Upon receipt of such written notice from the Authority or OAR, the Contractor shall take all steps necessary to complete the work in a timely manner to minimize any impact to operations. Once the incomplete work has been completed, the Contractor shall prepare and issue a Certificate of Project Completion per the requirements set forth in this specification. The Authority and OAR shall then re-inspect the work upon Contractor's request at a scheduled re-inspection time.
 - a. The written notice issued by the Authority and/or OAR will include a maximum compliance period, not to exceed 30 calendar days. The Authority or OAR, at its discretion, may define a compliance period which is shorter based on project needs, project schedule constraints or other extenuating circumstances. If the nature or complexity of the work required to comply with the written notice is such that it cannot be completed within the required compliance period, the Contractor shall immediately notify the Owner and OAR in writing. The notification from the Contractor shall include a detailed, resource-loaded schedule indicating when and how the work will be completed, subject to approval by the Authority or OAR. Until such a schedule is approved by the Authority or OAR, the original compliance period specified will stand.
 - b. If, at any time during the compliance period, the Authority or OAR determines that the Contractor is not progressing satisfactorily with the steps necessary to complete the work in a timely fashion, or if the Contractor fails to complete the work within the compliance period or by the completion date approved by the Authority or OAR, the Authority shall have the right to pursue liquidated damages and/or Contract with a third party in order to complete and/or inspect any work of which Contractor failed to conform with the Contract requirements. All costs associated with the Authority's actions to complete and/or inspect any work not conforming with contract documents shall be borne by the original Contractor responsible for delivering the project.

C. Inspections

1. At the completion of the project and prior to final acceptance of the Work, provide evidence of final inspections and approvals to The Authority, in accordance with all requirements of the Contract Documents as well as required by the authorities having jurisdiction.
2. Authority approval is required prior to final system acceptance and payment.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

END OF SECTION 27 05 00

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

SECTION 27 10 00
PREMISE DISTRIBUTION SYSTEMS

PART 1 – GENERAL

1.1 STIPULATIONS

- A. Drawings and general provisions of the Contract, including Division 00 and Division 01 Specification sections apply to this Section.
- B. The GOAA Standard Voice and Data Infrastructure Cable and Pathways Labeling Format document in its entirety. This document is included as an attachment in this section, and it applies for all cables and pathways installed, including but not limited to used conduits, spare conduits, inner-ducts, manholes, and underground duct-bank. Any references made to cable and pathway labeling directives for inside Premise Distribution Systems or Outside Plant installations include all components of this document.

1.2 SUMMARY

- A. This section includes the requirements for provision and installation of Premise Distribution Systems (PDS) including Outside Plant (OSP) backbone cabling and pathways, comprised of voice and data subsystems for the Orlando International Employee Parking Lot.

1.3 SCOPE OF WORK

- A. Authority-Furnished Equipment (Owner-Furnished Equipment (OFE))
 - 1. The Contractor shall coordinate with the Authority and OAR for pick-up of all OFE to be installed by the Contractor. The Contractor shall coordinate with the Authority in advance for specific pick-up location of OFE and to obtain access to such locations. The Authority shall not be responsible for delivery of OFE to be installed under this contract to the construction site. The hand-off of OFE between the Authority and the Contractor may occur multiple times throughout the project to permit configuration by either party after delivery and prior to installation.
 - 2. Immediately inspect all OFE upon pick-up for damage and/or defects. Notify the Authority and OAR in writing of any damage or defects immediately upon discovery. The contractor shall assume full responsibility for any unreported damage and/or defects to OFE.
 - 3. The Contractor shall provide all vehicles, hand trucks, carts and other means of transporting OFE within the project site. The Contractor shall transport OFE from the point of delivery to the point of installation.
 - 4. Refer to Part 1 Delivery, Storage and Handling requirements of this specification section and all related Division 27 and 28 specification sections for additional requirements.
- B. Authority and Authority Vendor-Furnished Equipment and Services

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

1. Portions of this project shall be furnished and installed by the Authority and/or Authority Vendors. The contractor shall identify elements of the project provided by Authority and/or Authority Vendors that impact the contractor's scope of work and coordinate all work with such parties. Schedule work to permit authority vendors' access to required work areas with sufficient time to complete tasks in accordance with the Project Schedule. Refer to related specification sections for additional information.
 2. The Authority Vendor shall actively attend meetings to coordinate work and construction with the Contractor.
 3. The Authority Vendor shall provide all equipment, tools, and services to complete work as described in the Contract Documents.
- C. Where listed on the drawing, the following components shall be defined as follows:
1. Network Components: GOAA will furnish and install all required network switches and other active elements for network connectivity. The network includes layer 2 access and distribution or layer 3 core and router switches to connect a system to the GOAA Passive Optical Lan and Local Area Network.
- D. The Contractor shall coordinate with the OAR for work related to any GOAA furnished, GOAA installed, and GOAA vendor work.
- E. The below detail the general products to be provided by the Contractor: Refer to Part 2 of this specifications for additional details.
1. Wall Mounted Fiber Cabinet to be located in Guard Booth indicated on plans. Cabinet shall contain all accessories specified herein.
 2. (2) 48 strand Rack Mounted Fiber LIU. One LIU to be installed in existing South Taxi Hold IDF room. Second LIU to be installed in new Guard Booth cabinet.
 3. Installation of all outside plant fiber. Includes fiber from Guard Booth to existing IDF. In addition, fiber from guard booth to camera pole locations and Communication enclosures.
 4. Termination and Testing of fiber at LIUs. ST Style connectors to be used.
 5. Low voltage wiring to new Blue Phone locations. Shall include termination of copper cabling in new 110 block in Guard Booth.
 6. Coordination with SkiData for the extension of the revenue control network. New Transcore equipment to be installed at Bus Entrance/Exit locations by contractor. Contractor to coordinate with SkiData during project kickoff.
- F. Owner Furnished Contractor Installed products:
1. The below detail products to be furnished by the Grater Orlando Aviation Authority (Owner) and to be installed by contractor. Contractor shall coordinate with owner at the beginning of the job to obtaining these items:

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- a. Uninterruptable Power Supply (UPS)
 - b. Ethernet Switches
 - c. Power Distribution Unit (PDU)
 - d. Fiber Patches from LIU to Ethernet Switch
 - e. IP Audio Converter for Blue Phones
- G. The following components list the roles and responsibilities of GOAA and the Contractor:
- 1. Integration to Existing System: All wiring, cabling, interface devices and appurtenances as required to extend the physical or logical scope of an existing system, or to incorporate a new or disparate system into an existing system. This shall include fiber channeling – refer to Backbone Cable below for additional information. Refer to related specification sections for additional information.
 - 2. Interfaces: All hardware, software, wiring, cabling, programming, interface devices and appurtenances as required for communication between systems, or between a given system and an operator, to provide the specified functionality. Refer to related specification sections for additional information.
 - 3. Backbone Cable: The segment of the premises distribution system that provides inter-building and intra-building connectivity between entrance facilities, equipment rooms and other telecommunications spaces including telecommunications rooms and telecommunications enclosures.. Contractor shall furnish and install all backbone cabling, pathways, conduit, termination equipment, communication room fittings, grounding, testing, labeling, and all other work included in this specification section. Contractor shall provide fiber channeling in order to achieve required connectivity to the NTC and all other portions of Airport in support of all telecommunications systems.
 - 4. Horizontal Cable: The segment of the premises distribution system that provides connectivity from communications spaces to field devices. Contractor shall furnish and install all horizontal cabling, pathways, conduit, termination equipment, communication room fittings, grounding, testing, labeling, and all other work included in this specification section. Furnish all patch cables required for all network-connected systems and to support all spare patch panel connections within communications spaces (IDFs/MDF). Refer to related specifications for information regarding responsibility for installation of patch cables.
 - 5. Field Devices: Components of a system which are served by the system headend and are the network endpoint or “edge” device. Contractor shall furnish and install data outlets, premise distribution system testing, labeling, and all other work included in this specification section.

1.4 SYSTEM DESCRIPTION

- A. Furnish and install a complete Premise Distribution System (PDS) including Outside Plant (OSP) backbone cabling system, including all necessary tools, materials, equipment, labor, and testing to provide a complete system. This system shall

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

enable all GOAA low voltage systems to be fully operational according to design specifications at project completion, complying with these specifications and all regulatory requirements. The system shall include but not be limited to:

1. Backbone Cabling: Fiber and copper cabling including inside and outside plant installations as required. All fiber and copper voice/data/systems cabling necessary for a complete and fully operational Premise Distribution System.
2. Backbone Pathway: Conform to ANSI/TIA-569D – 2015 using conduit, cable tray, backboards, etc. as indicated.
3. Outside Plant backbone cabling. To include buried conduit/duct bank cable and pathways as specified in project. The GOAA Standard Voice and Data Infrastructure Cable and Pathways Labeling Format document applies for all cables and pathways installed, including but not limited to used conduits, spare conduits, inner-ducts, manholes, and underground duct-bank.
4. Horizontal Pathway: Conform to ANSI/TIA-569D – 2015 using conduit, cable tray, backboards, cabinets, etc. as indicated. All cable is to be installed in conduit unless approved otherwise by GOAA in writing as a response to a written request by a member of the Design/Project Team.
5. All references to cable installations within this document include complete installation specifications, including but not limited to: "installed, terminated, tested and administered".
6. All references to testing include complete testing procedures, including but not limited to: "results are to be recorded in the test device, printed and submitted in hardcopy and in electronic format". See details on testing.
7. Horizontal Cabling: Complete from Premise Distribution System Equipment to each outlet using cable (copper or fiber optics) as specified.
8. Outlets: Provide outlets as required. All cabling whether fiber optic or copper installed terminated and tested.
9. Raceways, outlet boxes, cabinets, identification, etc.: Conform to applicable sections in Division 26 and 27 specifications.
10. Cabinets and racks: Conform to applicable sections in these specifications.
 - a. All cabinets shall have internal vertical and horizontal cable management panels.
 - b. All racks shall have cable management components.
 - c. Cabinet and rack installations shall have overhead cable tray installed.
 - d. All cabinets shall have vented front doors, split vented rear doors, and vented side panels for adequate airflow for proposed equipment to be installed.
 - e. All cabinets shall have locking front and rear doors. Locks shall be independently keyed to GOAA PDS cabinet key.
 - f. All cabinets and racks shall be furnished with a vertical rack bonding busbar.
11. Patch panels - Provide and install the required patch panels for fiber optic cables and copper cables. All LIUs (FO) panels to have locking metal framed or metal covers with hasps (front and rear) for a padlock.
12. Surge suppression shall be provided on all cables entering or leaving the footprint of the building or exterior device subject to surge. See below section for additional surge suppression requirements.
13. Fireproofing equivalent to a one-hour rating shall be provided on all

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- communications room penetrations.
14. Systems rooms overhead cable trays: all cable trays shall be mounted per manufacturers specifications complete with all hardware and rubber boots on ends. Corner or T-sections shall be provided with corner bracket sweep or a bend section.
 15. All cable trays shall be a minimum of 12 inches from any source of EMI or other sources of electrical interference. The Contractor shall follow industry standards and best practices in maintaining proper separation from EMI and other sources of electrical interference.
 16. All racks or cabinets shall be installed with overhead fiber optic trough system with an open channel design to protect and route fiber optic patch cords. Trough shall have downspouts and drop-outs over each rack side. Refer to drawings for side of ladder rack that fiber optic trough system shall be installed on.
 17. All locations that have Fiber Optic (FO) or copper cabling mounted on Communication Room walls shall have overhead cable ladder rack and overhead fiber optic trough system with an open channel design to protect and route fiber optic patch cords installed from any new racks or cabinets to wall or other existing rack(s) to create cable pathways. In addition, Communications Room walls shall have D-rings and/or other vertical and horizontal cable management to support cabling. Zip ties shall not be used as cable management.
 18. All under floor cable pathways shall be completed as described above providing cable pathways between components, using under-floor system.
 19. Transition pans with dividing fingers shall be furnished and installed on ladder rack above racks and equipment cabinets in quantities and locations as necessary to properly support and route copper cables and patch cords, including patch cords installed by GOAA or GOAA Vendor(s). Transition pans shall match racks (black) in color and be provided by the same manufacturer as the rack.
 20. Backbone cable shall be secured by hook-and-loop (Velcro) cable ties on overhead rack and into LIUs (fiber).
 21. Backbone cables shall not be broken out of the cable jacket except within enclosures designed to protect and support cable breakouts.
 22. All horizontal fiber and copper, and patch cords cable shall be secured by black Velcro wrap as necessary.
 - a. Velcro wrap shall be cut from 1 inch by 10 yard roll (industry standard supply) for cable bundles.
 - b. Individual black Velcro cable ties may be used where appropriate.
 - c. Velcro cable ties shall be solid black without any manufacturers name, logo, or other imprinted on wrap.
- B. Coordinate all work related to equipment provided by the Owner and/or Owner's vendor(s).
1. Where new telephone, network, and other systems equipment provided by Owner (GOAA) is to be installed as a requirement in project, a systems meeting is required with GOAA Information Technology Department no longer than three (3) weeks after Notice To Proceed is issued and thereafter on a

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

monthly basis.

- C. Provide all power, grounding, plywood backboards and complete raceway system. Refer to Division 26 for power and grounding requirements.
- D. Complete Telecommunication Infrastructure element labeling according to ANSI/TIA 606 and GOAA requirements as specified in this document.
 - 1. Labeling format samples and required Telecommunication Infrastructure Record Administration forms are included in this specification document.
 - 2. All Infrastructure Element labeling shall be complete and Telecommunications Infrastructure Administration Records shall be submitted prior to the infrastructure being put into use, at the same time all cable test records are submitted.
- E. Completion of the PDS and OSP cabling system in its entirety is required by Substantial Completion inspection, including submission of system test report documents.
 - 1. If Owner provided or Contractor provided equipment requires the use of systems cabling infrastructure to have any Electronic Systems operational for the project to meet Substantial Completion inspection requirements the cabling infrastructure shall be complete and tested in its entirety according to a previously coordinated schedule providing reasonable and adequate time for Electronic Systems to be installed, tested and made operational.
 - 2. No cabling infrastructure is to be put into use without being complete and fully tested according to these and Project Engineering specifications.
- F. Where any active Electronic Systems are installed by any party requiring installation of fiber or copper patch cords, all patch cords shall be permanently and properly routed in the pathway created for same, and the patch cords shall be labeled on each end with source/destination according to GOAA Labeling Specification. All patch panel or LIU User Identification tables shall be filled out as to use/user.

1.5 SUBMITTALS

- A. Product data shall be submitted on all products used to complete the scope of work of this project, including but not limited to:
 - 1. Catalog cut sheets.
 - 2. Roughing-in diagrams
 - 3. Proof of UL Listing. Indicate the UL listing, the UL classification, and NEC insulation type used for each type of cable to be used in installation of the Premise Distribution System. Provide a complete copy of the UL Test report substantiating that the cable meets ANSI/TIA requirements.
 - 4. UL Verification of Category 6 and 6A equipment and material.
 - 5. Installation instructions. Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation.
 - 6. Manufacturers Certificate: Certify that products meet or exceed specified requirements.
 - 7. Test results from manufacturer showing product has passed quality control tests at factory (specifically fiber optic cabling, as well as other applicable

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- products.
- 8. Submit test reports from manufacturers', specifications and any other information necessary to determine compliance with material and equipment specified.
- 9. Operation and maintenance manuals.
- B. Shop Drawings: Submit plan of building(s) and site showing pathways with all installed cables and pathways noted.
 - 1. Shop Drawings for enclosures shall include plans, elevations, sections, and attachment details indicating sizes of equipment, their relationship, and clear space within the enclosure.
 - 2. Detailed floor plan layouts and riser diagrams showing system components and their location, interconnections, wiring/cablings, and interface and connection with other disciplines.
 - 3. Coordination Drawings in accordance with the requirements of Division 01.
 - 4. Detailed data as requested by designer/OAR.
 - 5. Point to point wiring diagrams and block diagrams of system to be installed.
 - 6. Submit a detailed step by step testing procedure for any active components, component/ system functional checkout and test.
 - 7. Coordination: Shop drawing plans shall include pathway routing, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - a. Structural members in paths of pathway groups with common supports.
 - b. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- C. Detail drawings of each of the facilities terminal boards/cabinets, and equipment rack elevations for all MDF and IDF locations.
- D. Qualifications: Submit qualifications of system installer including but not limited to:
 - 1. Contractor's license.
 - 2. A list of a minimum of three (3) recently completed PDS projects of similar type and size with contact names and telephone numbers for each that the Contractor has performed within the last two (2) years.
 - 3. Documentation of the Contractor's staff member(s) who are BICSI Certified Installation Technicians. The documentation shall be current copies of the certificate issued by BICSI.
 - 4. A letter certifying the Contractor maintains an office within fifty (50) miles of the project location.
 - 5. Proof of certification by the manufacturer(s): Documentation that the Contractor is an authorized and designated installer for the equipment manufacturers whose products he intends to install.
 - 6. Technical resume of the Contractor's Project Manager and Field Supervisor documenting a minimum of five (5) years' experience installing Premise Distribution Systems.
 - 7. Technical resume for any sub-contractor who will assist the PDS Contractor in performance of this work.
 - 8. A list of test equipment proposed for use.
 - a. For testing copper or metallic cabling components.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- b. For testing fiber optic cabling components.
- c. Include test certificate verifying that all test instruments have been calibrated within one prior year of anticipated testing completion of project.

1.6 QUALITY ASSURANCE

- A. Refer to Specification Section 27 05 00 for requirements.

DELIVERY, STORAGE, AND HANDLING

- B. Refer to Specification Section 27 05 00 for requirements.

1.7 RECORD DOCUMENTS

- A. As-Built documents shall include updating and revising contract documents to record actual locations (as-installed) of all equipment, pull boxes, devices, IDF's, raceways, cabling, Telecommunication Outlets, and all Premise Distribution and all Outside Plant cable infrastructure components.
- B. As-Built PDS and OSP riser diagrams shall be submitted.
- C. All drawings required herein shall be in AutoCAD Latest Release or format required by Division 01 specifications.
- D. Drawings required herein are in addition to those required under "OPERATION AND MAINTENANCE DATA."
- E. Telecommunication Outlet label information sheet: An E size sheet(s) copy of the Electrical, Power or Systems project plan sheet that shows all Telecommunication outlets in office/building spaces with all TO final label information typed in by each TO symbol in each room shall be submitted to GOAA OAR and GOAA Information Technology department. This document shall be submitted by Substantial Completion Inspection or earlier. This sheet is required a minimum of three weeks prior to any need to have any voice/data jacks to be made active for any purpose.

1.8 OPERATION AND MAINTENANCE

- A. Refer to Specification Section 27 05 00 in addition to the following.
- B. O & M Manuals shall include:
 - 1. A complete as-installed equipment list of active (powered) components, including Owner Furnished Equipment. Equipment shall be listed by room, with manufacturers' names, model numbers, serial numbers, and quantities of each item.
 - 2. A complete and correct system schematic, showing detailed connections for all parts of the system, including cable numbers, terminal block numbers and layouts, and other designations and coding's (point-to-point wiring diagrams). System performance measurements shall be documented as noted elsewhere in this specification.
 - 3. Riser diagrams showing as-installed conduit with pull boxes, outlet boxes, physical cable layouts, part numbers of cable types used, and number of circuits in each conduit.
 - 4. Repair parts list for each major equipment item furnished.
 - 5. A list of spare repair parts provided by the Project with a copy of the

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

Transmittal Sheet showing who took receipt of and where the spare parts are stored.

6. Service manuals for each major equipment item furnished.
 - a. Manual(s) shall be bound separately and labeled appropriately.
 - b. Include instructions for adjusting, operating, and extending the system
 - c. Manufacturer's warranties and operating instructions for each active equipment item furnished.
 - d. Recommended preventive maintenance procedures.
7. Test Data: record of results for all copper, metallic, and fiber optic cables installed and tested, or tested.
 - a. Test data shall be formatted according to GOAA Standard and ANSI/TIA 606 Administration Standards.
 - b. Test results shall be submitted in in electronic form.
 - c. Include all fiber tests with performance graph from OTDR. Single Mode and Multi-Mode shall be OTDR tested. All fiber utilized for the installation of Project Systems required by the project scope shall be tested whether or not the cable was installed by the Contractor.
8. Data sheets showing all field labeling used for termination blocks, and cable (outside plant, backbone, riser and horizontal) runs.
9. Cable Data for all backbone (riser) and horizontal fiber and copper indicating type and use of cable installed by Contractor and to include:
 - a. Manufacturer's specification sheet.
 - b. Manufacturers performance and warranty sheet.
 - c. Date manufactured.
 - d. Part number.
 - e. Serial number.
 - f. Reel number.
 - g. Description.
 - h. Attenuation specifications.
 - i. Bandwidth specifications.
10. Complete equipment rack/cabinet layouts showing locations of all rack mounted patch panels, and equipment items.

1.9 SOFTWARE AGREEMENT

- A. Refer to Specification Section 27 05 00 for requirements.

1.10 SPARE MATERIAL

- A. Refer to Specification Section 27 05 00 for requirements in addition to the following.

1.11 ENVIRONMENTAL CONDITIONS

- A. Refer to Specification Section 27 05 00 for requirements.

1.12 SUBSTANTIAL COMPLETION INSPECTION REQUIREMENTS

- A. Refer to Specification Section 27 05 00 in addition to the following.
- B. These Substantial Completion requirements are additional to Drawings and general provisions of the Contract, including Division 00 and Division 01 Specification sections apply to this Section.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- C. The Substantial Completion inspection shall cover all locations where PDS components and/or Systems have been installed and/or modified.
- D. The Substantial Completion inspection shall be coordinated by the Technical Project Manager with the Contractor, Project Manager, and GOAA Telecom/IT Representative attending.
- E. A separate PDS and Systems inspection may be requested by GOAA OAR or GOAA Information Technology Department.
- F. All cabling testing and labeling shall be completed by Substantial Completion Inspection, or prior to being put into service, whichever comes first.
- G. All cabling test results' documents shall be submitted to the Technical Project Manager, GOAA OAR, with a copy to GOAA Information Technology Department.
- H. All labeling documents shall be submitted to the Technical Project Manager, GOAA OAR, with a copy to GOAA Information Technology Department.
- I. If Owner provided or Contractor provided equipment requires the use of systems cabling infrastructure to have any Electronic Systems operational for the project to meet Substantial Completion inspection requirements the cabling infrastructure shall be complete and tested in its entirety according to a previously coordinated schedule providing reasonable and adequate time for Electronic Systems to be installed.
- J. Where any active Electronic Systems are installed by any party requiring use of new or existing fiber or copper backbone or horizontal cables, the installation of fiber or copper patch cords shall be complete; all patch cords shall be permanently and properly routed in the pathway created for same, and the patch cords shall be labeled on each end with source/destination according to GOAA Labeling Specifications. All patch panel or LIU User Identification tables shall be filled out as to use/user. This must be demonstrated as complete by Substantial Completion inspection.
- K. Where new or expansion Systems are installed using new or existing backbone or horizontal fiber strands, and other new or existing fiber strands becomes unused, all strands that became unused shall have their corresponding patch cords removed along the entire fiber cable route. All User ID cards information shall be erased or covered with white adhesive paper to indicate those strands are no longer in use. Marking out fields in User ID cards is prohibited. This shall be demonstrated during Substantial Completion inspection.
- L. Telecommunication Outlet-to-Label space information sheet shall be provided:
 - 1. An E size sheet(s) copy of the Power or Systems project plan sheet that shows all Telecommunication Outlets (TO) in office/building spaces, that has all TO final label information typed in by each TO symbol in each room is to be submitted to GOAA OAR and GOAA Information Technology Department.
 - 2. Two copies shall be submitted to GOAA Information Technology Department.
 - 3. This document shall be submitted by Substantial Completion Inspection or earlier. This sheet is required a minimum of three weeks prior to any need to have any voice/data jacks, dry pairs, or any outlet to be made active for any purpose.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

PART 2– PRODUCTS

2.1 GENERAL

- A. All equipment shall be new and unused. All components and systems shall be designed for uninterrupted duty. All equipment, materials, accessories, devices, and other facilities covered by this specification or noted on the contract drawings shall be the best suited for the intended use and a single manufacturer shall provide component assemblies.
- B. Provide all components, equipment, parts, accessories and associated quantities required for complete installations and according to Manufacturers installation specifications. All components may not be specified herein.
- C. All devices/components/products shall be suitable for use intended, and meet all stated performance requirements for PDS, OSP and Systems configurations specified in this document.

2.2 PATHWAYS/CONDUIT/RACEWAYS

- A. General:
 - 1. All pathways (conduit, raceways, wireways, pullboxes, outlet boxes, etc.) shall comply with applicable requirements of sections within these specifications.
 - 2. All pathways (conduit, raceways, wireways, pull boxes, outlet boxes, etc.) shall comply with all requirements of ANSI/TIA-569D-2015.
 - 3. Size: All horizontal pathways shall be minimum 1” conduit. Pathways shall be increased in size to properly accommodate number of cables to a maximum of 24 cables. Backbone conduits shall have at least 20% of installed innerduct pathways spare.
 - 4. All conduits shall be sized and installed per NEC and ANSI/TIA specifications for intended use.
 - 5. Size: All backbone conduit shall be a minimum 2” conduit.
 - 6. Long Radius (sweep) bends shall be used for all fiber optic cable pathways, sized per NEC and ANSI/TIA specifications for intended use.
 - 7. No pathway components shall be installed that force cables to exceed manufacturer’s recommended bend radius during installation or when pulling of cable is complete.
 - 8. For all horizontal pathways, there shall be no more than 180-degrees of total bend between any two pull points.
 - 9. Pull-boxes shall not be used as direction changes but be used to pull straight through.
 - 10. Where a pull-box is required with raceway(s) smaller than 1-1/4 trade size, an outlet box may be used as a pull-box.
 - 11. Where a pullbox is used with raceway(s) of 1-1/4 trade size or larger, the pull box shall:
 - a. Have a length of at least 8 times the trade size diameter of the largest raceway.
 - b. Be individually labeled and installation location marked on As-Builts.
 - 12. Metal flexible conduit shall not be used for PDS system.
 - 13. Protective bushings: All backbone and horizontal conduits shall have plastic/nylon insulating bushings installed on all ends to protect cable.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

14. All backbone and horizontal conduits shall have ground bonding bushings with lugs installed on ends that terminate in a communications room and be bonded to the Systems Ground Bus Bar with an insulated #6 AWG wire.
 15. All conduit shall be labeled with source/destination at each end, and each main pull box. See GOAA Cable and Pathways specifications.
 16. Pull Cords/Pull Tape: Install pull cords in all raceway runs including conduit and inner-ducts that are installed without cable (empty). Install a pull string or pull rope in all horizontal and backbone conduits and inner-ducts that have cable installed (used).
 17. Boxes:
 - a. All outlet boxes, junction boxes, pull boxes, etc. shall comply with applicable sections of these specifications.
 - b. Outlet boxes shall be deep with a minimum size of 4-11/16" by 4-11/6" by 2-1/8" deep with a single gang sheetrock ring.
 - c. Boxes shall be sized as required by ANSI/TIA and NEC for cables, both fiber and copper (metallic), conduit and/or device installed.
- B. Rigid Steel Conduit:
1. Conduit shall be seamless, hot dipped galvanized rigid steel.
 2. Threads shall be cut and ends chamfered prior to galvanizing.
 3. Galvanized to provide zinc coating fused to inside and outside walls of conduit.
 4. Provide an enamel lubricating coating on the inside of the conduit.
 5. Conduit shall conform to ANSI C80.1 and listed and labeled under UL 6.
- C. Rigid Aluminum Conduit:
1. Conduit shall be seamless, 6063 alloy, T-1 temper.
 2. Conduit shall conform to FS WW-C-581d, ANSI C80.1, and UL 6.
 3. Pass bending, ductility, and thickness of zinc coating in ANSI C80.1.
- D. Intermediate Metal Conduit:
1. Conduit shall be seamless, hot dipped galvanized rigid steel.
 2. Threads shall be cut and ends chamfered prior to galvanizing.
 3. Galvanizing shall provide zinc coating fused to outside walls of conduit.
 4. Provide an enamel lubricating coating on the inside of the conduit.
 5. Conduit shall be listed and labeled under UL 1242.
- E. Electrical Metallic Tubing (EMT):
1. EMT fittings shall be formed steel compression ring type. Die cast fittings are not allowed.
 2. EMT shall be UL listed and conform to NEC Article 300.22.
 3. Shall be used inside buildings only.
 4. Only manufactured fittings, transition adapters, terminators and fixed bends shall be used.
 5. All transition junction and pull boxes, fittings terminators and adapters shall be a metallic material.
- F. Raintight Sealing Hubs:
1. Two piece type with outer internally-threaded hub to receive conduit, inner

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- locking ring with bonding screw, insulated throat, and V shaped ring or O-ring.
 2. Manufacturers: Thomas & Betts H series or Bridgeport.
- G. Conduit Bodies: Not Permitted.
- H. Conduit Fittings:
1. All fittings shall be compression or threaded.
 2. Fittings shall provide a secure connection for pulling communications cables.
 3. Setscrew fittings are not permitted.
 4. ANSI/NEMA FB 1; material to match conduit.
 5. Couplings for rigid steel conduit and IMC to be single piece threaded, cadmium plated malleable iron.
 6. Couplings for rigid aluminum conduit to be of aluminum construction, 6063 alloy.
 7. Hubs for box connection to be two-piece with outer internally threaded hub to receive conduit and inner locking ring with bonding screw.
 8. Expansion fittings shall allow for a minimum of four inches of movement and shall be similar to O-Z Gedney AX series, complete with bonding jumpers and hardware.
- I. Non-metallic conduits are not permitted in above ground installations. Conversion fittings are required for non-metallic (below ground) to metallic (above ground) transitions.
- J. Innerduct:
1. Application: Suitable for an indoor or duct bank installation within a riser system or backbone conduit for the support of telecommunications fiber optic cables.
 2. Material, as specified on drawings for each application:
 - a. Multi-cell flexible fabric.
 - b. 3-cell flexible fabric or greater, as indicated on the drawings, for duct bank installation.
 - c. 3-cell flexible fabric, riser rated, for indoor installation.
- K. Pull Cord / Pull Tape:
1. Pre-lubricated, woven polyester, low friction, and high abrasion resistant yarn.
 2. Minimum average tensile strength shall be 1250 lbs. for 2 inch and smaller conduits and innerduct.
 3. Minimum average tensile strength shall be 1800 lbs. for conduits larger than 2 inches.
- L. Pull Boxes, Junction Boxes, and Gutters:
1. All junction boxes, gutters and pull boxes shall comply with NEC Article 314.
 2. All junction boxes, gutters and pull boxes shall meet the following minimum material requirements:
 - a. 16-gauge steel or heavier.
 - b. Seams shall be continuously welded and grounded smooth.
 - c. External screws and clamps.
 - d. External mounting feet (where possible).

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- e. Oil-resistant gasket and adhesive.
 - f. ANSI 61 gray polyester powder coating inside and out over phosphatized surface.
 - g. UL 50 type 12.
- 3. All junction boxes, gutters and pull boxes shall be provided with bushings for conduits and/or cabling.
 - 4. All junction boxes shall be provided with a hinged cover. Where clearances do not allow full opening of hinged cover, bolt on covers with captive nuts shall be provided.
 - 5. All junction boxes, gutters and pull boxes shall be securely installed.
 - 6. All junction boxes, gutters and pull box configurations and sizes for single and multiple conduit runs shall comply with ANSI/TIA 569.
- M. Metal Wireways and Auxiliary Gutters:
- 1. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
 - a. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - b. Comply with TIA-569-B.
 - 2. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
 - 3. Wireway Covers: Hinged type unless otherwise indicated.
 - 4. Finish: Manufacturer's standard enamel finish.
- N. Boxes, Enclosures, and Cabinets:
- 1. General Requirements for Boxes, Enclosures, and Cabinets:
 - a. Comply with TIA-569-B.
 - b. Boxes, enclosures and cabinets installed in wet locations shall be listed for use in wet locations.
 - 2. Sheet-Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
 - 3. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
 - 4. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
 - 5. Device Box Dimensions: 4-11/16" inches by 4-11/16" inches by 2-1/8 inches deep with mud ring.
 - 6. Gangable boxes are allowed.
 - 7. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
 - 8. Cabinets:
 - a. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - b. Hinged door in front cover with flush latch and concealed hinge.
 - c. Key latch to match panelboards.
 - d. Metal barriers to separate wiring of different systems and voltage.
 - e. Accessory feet where required for freestanding equipment.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- f. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- O. Handholes and Maintenance Holes for Exterior Underground Cabling:
 - 1. General Requirements for Handholes and Maintenance Holes:
 - a. Handholes and maintenance holes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
 - b. Comply with TIA-569-B.
 - 2. Polymer-Concrete Handholes and Maintenance Holes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass or a combination of the two.
 - a. Refer to drawings for handhole and maintenance hole sizes.
 - b. Standard: Comply with SCTE 77.
 - c. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.
 - d. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and location.
 - e. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - f. Cover Legend: Molded lettering, "Communications".
 - g. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 - h. Handholes and maintenance holes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.3 TERMINATION BACKBOARDS

- A. Material: 3/4" A/C grade, Class A Flame Spread plywood.
- B. Size: to accommodate telephone termination equipment. Coordinate with size of backboard with Guard booth provider.
- C. Finish: Paint terminal board with gray paint having a flame spread rating of Class A as a minimum. Do not paint over Class A flame spread information on plywood.
- D. Install label on backboard with TTB# and Room#.

2.4 "SYSTEMS" AND "LOCAL" GROUND BUS

- A. Ground Bus shall be copper and comply with applicable sections of these specifications.
- B. Install minimum one copper ground bus with qty (12) pre-drilled 1/4" holes on isolating stand-offs of TTB backboard. Holes shall be configured to accept two-hole lugs.
- C. Basis of Design: Chatsworth #10622-012 or approved substitution.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

2.5 COMMUNICATION ROOMS AND SIMILAR SPACES

- A. With the exception of cable management devices and rack/cabinet equipment below, devices shall be installed per requirements determined in the field by the Project Engineer and Contractor as required to neatly dress/organize cables in and out of rack/cabinets.
- B. No metallic or fiber cables shall be unsupported, or potential patch cord routes be without a supported pathway.
- C. Fiber optic patch cable pathways shall be routed and specifically constructed for protective fiber cable routing.

2.6 WALL MOUNT EQUIPMENT CABINETS

- A. Standard wall mount cabinet. Install in Guard Booth room.
 - 1. Universal self-supporting all aluminum rack 48" H. x 24" W. x 24" D.
 - 2. 26U of interior mounting space
 - 3. Door lock to be compatible with GOAA provided Blue Tooth Lock.
 - 4. 19" EIA equipment mounting rails
 - 5. Conduit knock Outs.
 - 6. Dual Fan kit for equipment cooling.
 - 7. Use heavy-duty assembly hardware.
 - 8. 300lb load rating.
 - 9. Cable management accessories to be included.
 - 10. Finish: Black.
 - 11. Rack Basis of Design: Chatsworth Cube-iT.
 - 12. Acceptable substitutions:
 - a. Homaco.
 - b. Hubbell.
- B. Rack and Cabinet Equipment
 - 1. All rack equipment, wire managers, PDUs (power distribution units), etc. shall be black.
 - 2. All racks/cabinets shall be provided with black equipment mounting screws.
 - 3. Provide cable management devices (clamps, guides, supports, etc. as required to neatly dress/organize cables in and out of rack (or enclosure).
 - 4. Provide horizontal and vertical (full rack height) cable management. Cable management fill rate shall not exceed 50% condition when all provided jacks are in use.
 - 5. All Rack/Cabinet equipment shall be provided by the same manufacturer as the racks/cabinets with the following exceptions:
 - a. Horizontal wire management.
 - b. PDU.
- C. Horizontal Cable Managers:
 - 1. Horizontal wire managers shall have both front and rear channels with covers.
 - 2. Horizontal wire manager Basis of Design: Panduit WMPH3, or approved substitution.
- D. Vertical Cable Managers:

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

1. Cabinets:
 - a. Each cabinet shall have one full-length vertical cable manager installed internally on each side.
 - b. Vertical cable management shall be installed in rear of cabinet and provided by same manufacturer as the cabinet.
- E. Jumper Tray:
 1. Each rack shall have a jumper tray installed in the uppermost position.
 2. Each cabinet shall have a jumper tray installed in the uppermost position.
 3. Basis of Design for Jumper Tray: Chatsworth 12183 series.
- F. Power Distribution Unit (PDU):
 1. To be provided by Owner and Installed by contractor.
- G. Ground Bar:
 1. Cabinet
 - a. Provide full height minus 6" ground bar.
 - b. Mount in rear of cabinet and provide compression lug on top for connection to grounding system.
 - c. Connect to communication room TGB with minimum #6 THHN stranded wire; increase size of grounding cable to accommodate any ground cable installations of excessive lengths.
 - d. All grounding connections shall utilize non reversible connectors and lugs.
- H. Miscellaneous: Provide all necessary accessories as required to support the placement of non-rack mountable equipment (e.g. termination blocks, fiber optic extenders, audio codecs, etc.) into cabinets.

2.7 LABELS

- A. All Fiber Optic, metallic cable, TTBs (Telecom Spaces), Ground points, racks, cabinets, rack/cabinet-mounted equipment and cross-connects shall be identified and labeled per Attachment One: GOAA Standard Voice and Data Infrastructure Cable and Pathways Labeling Format document in its entirety, and according to ANSI/TIA 606 Administration Standards for Telecommunication Infrastructure of Commercial Buildings.
 1. All label material shall be suitable for intended usage and environment, meeting the legibility, defacement and general exposure requirements listed in UL 969 for indoor and outdoor use. Where insert labels are used the insert label shall be covered with clear cover and shall be securely held in place under the normal operating conditions and usage to which the labeled infrastructure element is applied.
 2. All items to be identified and labeled as listed above shall be labeled at the time they are installed.
- B. Label printer shall be of the thermal transfer type capable of printing self-laminating labels of various size up to and including 1.5 inch by 1.5 inch printable area with a 4.5 inch self-laminating tail.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- C. Label Printer Basis of Design: Brady BMP61 or approved equal.
- D. In addition to color coding requirements specified in Division 26, Pathways, backbone fiber optic cables, and backbone metallic cable labels shall have a 1.5 inch by 1.5 inch printable area white in color with a 4.5 inch self-laminating clear tail.
 - 1. Font shall be Arial Alt Mono 7 font size (11 point size).
 - 2. Label shall have the ability to have 15 characters per line and 8 lines for a total of 120 characters.
 - 3. Label Basis of Design: Brady P/N PTL-34-427 or approved equal, for inside use. For exterior use label shall follow the same character format, and meet the legibility, defacement, and general exposure requirements listed in UL 969.
 - 4. GOAA reserves the right to modify the label characters and character layout providing label materials do not change, at no cost.
 - 5. For all conduit or other pathways that have a diameter too large for the self-laminating label to over-wrap itself and fully laminate the printable area the label shall be changed to an insert type (tie-on is acceptable) and meet the exposure requirements in UL 969 for indoor and outdoor use. The insert label shall be covered with clear cover and shall be securely held in place under the normal operating conditions and usage to which the labeled infrastructure element is applied.
- E. Cables which shall be labeled include, but are not limited to, backbone, horizontal, patch cords, line cords, and jumpers.
- F. Contractor shall install all pathway and cable labels so they are visible and able to be read by a person standing on floor without moving cables, and if conduit/pathway, labels shall not be obscured by other conduit, or components. Any additional types of labeling materials necessary to keep labels visible shall be provided by the Contractor and installed by the Contractor.
- G. All metallic and fiber patch cords installed by Contractor or at direction of Contractor shall be labeled.
- H. Pathways are defined but not limited to; any conduit, inner-duct, underground duct-bank, cabling troughs, pull boxes, and any materials or systems used to enclose cabling of any type.
 - 1. Any pathways or cables whose label format is not specifically mentioned in the GOAA Standard Voice and Data Infrastructure Cable and Pathways Labeling Format document shall still be labeled in a similar format as directed by GOAA OAR/Telecom.
- I. All metallic/fiber horizontal cable and metallic/fiber patch cord labels shall have a 1 inch by 5 inch printable area white in color with a 1 inch self-laminating clear tail, labeled at each end.
 - 1. Font shall be Arial Alt Mono, 7 font size (11 point size).
 - 2. Label shall have the ability to have 15 characters per line and 2 lines for a total of 30 characters.
 - 3. Label Basis of Design is Brady P/N PTL-31-427 or approved equal, for inside use. For exterior use label shall follow the same character format, and meet

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

the legibility, defacement, and general exposure requirements listed in UL 969.

- J. Equipment cabinet / Rack labeling
 - 1. Provide phenolic nameplate fastened to top of racks and cabinets indicating rack / cabinet designation. Min 1" white text on black laminate.
 - a.

2.8 CABLE TESTER

- A. Copper cable tester technology required: basis of design: Fluke DSX-5000, or approved equivalent.

2.9 HORIZONTAL CABLING AND TERMINATION

A. Patch Panels:

- 1. Category 6 UTP Patch Panel:
 - a. Shall meet or exceed Category 6 rating for all components including but not limited to specifications within this document and as follows:
 - 1) IEEE 802.3AF (POE).
 - 2) IEEE 802.3AT (POE+).
 - 3) IEEE 802.3BT (POE++ 60W).
 - b. Component certified to meet or exceed Category 6 standards.
 - c. Configuration: Modular RJ-45 non-keyed 8-position jack port to 110 printed circuit board, factory pre-wired, Category 6.
 - d. Wire Plan: EIA/TIA T568B.
 - e. Active Pins: 1 through 8.
 - f. Individual patch panel size not to exceed 48 ports.
 - 1) One horizontal wire manager shall be installed for every 24 ports in patch panel configuration, between each patch panel(s).
 - g. Connection Hardware: IDC PCB (printed circuit board) mounted connector for 22-26 AWG.
 - h. Include strain relief bar.
 - i. UL listed and labeled.
 - j. Finish: Black.
 - k. Basis of Design: Optical Cable Corporation.
 - l. Approved Substitution:
 - 1) None.
- 2. Category 6A STP Patch Panel:
 - a. Shall meet or exceed Category 6A rating for all components including but not limited to specifications within this document and as follows:
 - 1) IEEE 802.3AF (POE).
 - 2) IEEE 802.3AT (POE+).
 - 3) IEEE 802.3BT (POE++ 60W).
 - b. Component certified to meet or exceed Category 6A standards.
 - c. Configuration: Modular Shielded RJ-45 non-keyed 8-position jack port to 110 printed circuit board, factory pre-wired, Category 6A.
 - d. Wire Plan: ANSI/TIA T568B.
 - e. Active Pins: 1 through 8.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- f. Must be backward compatible in all characteristics to Category 6 specifications.
 - g. Individual patch panel size not to exceed 48 ports.
 - 1) One horizontal wire manager shall be installed for every 24 ports in patch panel configuration, between each patch panel(s).
 - h. Connection Hardware: IDC PCB (printed circuit board) mounted connector for 22-26 AWG.
 - i. Include strain relief bar.
 - j. UL listed and labeled.
 - k. Quick Grounding bar design.
 - l. Provide strain relief on all cabling terminated in patch panel.
 - m. Provide shielded panel kit including bonding jumper.
 - n. Finish: Black.
 - o. Basis of Design: Optical Cable Corporation.
 - p. Approved Substitution:
 - 1) None.
3. Category 6A UTP Patch Panel:
- a. Shall meet or exceed Category 6A rating for all components including but not limited to specifications within this document and as follows:
 - 1) IEEE 802.3AF (POE).
 - 2) IEEE 802.3AT (POE+).
 - 3) IEEE 802.2BT (POE++ 60W).
 - b. Component certified to meet or exceed Category 6A standards.
 - c. Configuration: Modular RJ-45 non-keyed 8-position jack port to 110 printed circuit board, factory pre-wired, Category 6A.
 - d. Wire Plan: ANSI/TIA T568B.
 - e. Active Pins: 1 through 8.
 - f. Must be backward compatible in all characteristics to Category 6A specifications.
 - g. Individual patch panel size not to exceed 48 ports.
 - 1) One horizontal wire manager shall be installed for every 24 ports in patch panel configuration, between each patch panel(s).
 - h. Connection Hardware: IDC PCB (printed circuit board) mounted connector for 22-26 AWG.
 - i. UL listed and labeled.
 - j. Quick Grounding bar design.
 - k. Provide strain relief on all cabling terminated in patch panel.
 - l. Provide shielded panel kit including bonding jumper.
 - m. Finish: Black.
 - n. Basis of Design: Optical Cable Corporation.
 - o. Approved Substitution:
 - 1) None.
- B. Telecommunications Outlets:
- 1. Telecommunication Outlet (TO):
 - a. Provide all copper, metallic, and fiber optic cable as designed for Telecommunication Outlets indicated on the drawings.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- b. Provide Communication Outlet faceplates and jack modules for all type of cable media installed.
 - c. Jacks/ports/faceplates shall be provided from the same manufacturer.
 - d. All jacks installed in TO shall have colored bezel and dust shutter.
 - e. The TO faceplate shall have six port positions and be white or as specified by design to match surrounding area décor.
 - 1) Faceplate shall have a recessed label area covered by a clear plastic lens, at top and bottom covering screws.
 - 2) Exception: when face plate is stainless steel.
 - f. Refer to Attachment One in this specification document for GOAA Telecommunication Outlet label, Jack, and wiring configuration. "Data" and "LAN" nomenclature is interchangeable in this reference.
 - g. All Work Areas shall have GOAA Standard Telecommunication Outlets installed.
 - h. Basis of design: Optical Cable Corporation UMJ faceplate #FPSR06xx xx=color.
 - i. Approved substitution:
 - 1) Hubbell.
 - 2) Berk-Tek.
2. Wall Phone Outlet:
- a. Single port wall plates with mounting studs for wall telephone installed as specified and served by one (1) Category 6 cable.
 - b. Basis of design: Optical Cable Corporation.
 - c. Approved Substitution:
 - 1) Hubbell.
 - 2) Berk-Tek.
3. Floor Outlets:
- a. Shall be designed with separate chambers for voice/data/electrical per NEC and ANSI/TIA specifications for dual service use.
 - b. Voice and data jacks and mounting hardware shall meet ANSI/TIA Category 6 requirements for intended use.
 - c. Voice and data jacks shall be recessed to protect cable ends when in use.
 - d. Floor boxes shall have retractable covers to protect debris from entering voice and data jacks. Cover shall be capable of closing while jacks are in use.
 - e. Floor box basis of design: Legrand Evolution Series.
 - f. Approved Substitution:
 - 1) Hubbell.
- C. Telecommunications Modular Jacks:
- 1. Jacks and faceplates shall be by same manufacturer.
 - 2. Jacks and modular patch panels shall be by same manufacturer.
 - 3. Category 6 UTP Jacks:
 - a. Meets ANSI/TIA-568-C.2 Category 6 specifications for all components including but not limited to specifications within this document and as follows:
 - 1) IEEE 802.3AF (POE).

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- 2) IEEE 802.3AT (POE+).
 - 3) IEEE 802.3BT (POE++ 60W).
 - b. Supports IEEE 1000GBASE-T Ethernet.
 - c. Tool-less design allows for simple, consistent, reliable terminations.
 - d. Provide colored bezel for all jacks in accordance with Attachment 1 within this specification section.
 - e. Accommodates 22-24 AWG conductors.
 - f. Modular interface: 750 mating cycles.
 - g. 50 μ -inch gold-plated contacts.
 - h. Zinc alloy housing.
 - i. 1000 VDC Dielectric withstand.
 - j. 500 M Ω insulation resistance.
 - k. UL 1863 Listed.
 - l. Basis of Design: Optical Cable Corporation UMJ Series.
 - m. Acceptable substitution:
 - 1) Hubbell.
 - 2) Berk-Tek.
4. Category 6A STP Jacks:
- a. Shall meet or exceed Category 6A rating for all components including but not limited to specifications within this document and as follows:
 - 1) IEEE 802.3AF (POE).
 - 2) IEEE 802.3AT (POE+).
 - 3) IEEE 802.3BT (POE++ 60W).
 - b. Meets ANSI/TIA-568-C.2 Category 6A specifications.
 - c. Meets ISO/IEC 11801:2002 AMENDMENT 2 Class EA specifications.
 - d. Supports IEEE 802.3an 10GBASE-T Ethernet.
 - e. Tool-less design allows for simple, consistent, reliable terminations.
 - f. Provide colored bezel for all jacks as follows:
 - 1) Orange for standard Category 6A outlets.
 - g. Shielded housing to ensures superior ANEXT performance.
 - h. Accommodates 22-24 AWG conductors.
 - i. Modular interface: 750 mating cycles.
 - j. 50 μ -inch gold-plated contacts.
 - k. Zinc alloy housing.
 - l. 1000 VDC Dielectric withstand.
 - m. 500 M Ω insulation resistance.
 - n. UL 1863 Listed.
 - o. Basis of Design: Optical Cable Corporation UMJ Series.
 - p. Acceptable substitution:
 - 1) Hubbell.
 - 2) Berk-Tek.
5. Fiber Optic Jacks:
- a. Shall be modular style.
 - b. Shall be provided for MM or SM fiber cabling where required.
 - c. Dual LC or SC connector, as required by application.
 - d. Provide colored bezel for all jacks in accordance with Attachment 1 within this specification section.
 - e. Basis of Design: Optical Cable Corporation UMJ Series.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- f. Acceptable substitution:
 - 1) Hubbell.
 - 2) Berk-Tek.
- 6. Category 6A UTP Jacks:
 - a. Shall meet or exceed Category 6A rating for all components including but not limited to specifications within this document and as follows:
 - 1) IEEE 802.3AF (POE).
 - 2) IEEE 802.3AT (POE+).
 - 3) IEEE 802.3BT (POE++ 60W).
 - b. Meets ANSI/TIA-568-C.2 Category 6A specifications.
 - c. Meets ISO/IEC 11801:2002 AMENDMENT 2 Class EA specifications.
 - d. Supports IEEE 802.3an 10GBASE-T Ethernet.
 - e. Tool-less design allows for simple, consistent, reliable terminations.
 - f. Provide colored bezel for all jacks as follows:
 - 1) Orange for standard outlets.
 - g. Shielded housing to ensures superior ANEXT performance.
 - h. Accommodates 22-24 AWG conductors.
 - i. Modular interface: 750 mating cycles.
 - j. 50 μ -inch gold-plated contacts.
 - k. Zinc alloy housing.
 - l. 1000 VDC Dielectric withstand.
 - m. 500 M Ω insulation resistance.
 - n. UL 1863 Listed.
 - o. Basis of Design: Optical Cable Corporation UMJ Series.
 - p. Acceptable substitution:
 - 1) Hubbell.
 - 2) Berk-Tek.
- D. Horizontal Cable:
 - 1. All cable shall be installed, terminated, and tested by Contractor.
 - 2. All cable jacket and construction shall be applicable for the intended installation environment to maintain full manufacturer's warranty and industry standard expected life cycle, including but not limited to specifications within this document section.
 - 3. All cable shall include additional accessories such as clamps, supports, mounting hardware, straps, anchoring structures, termination hardware, etc. necessary to provide an industry standard installation in all environments. Accessories to include but are not limited to specifications within this document section.
 - 4. Terminate all horizontal cabling on rack mounted patch panels.
 - 5. Horizontal Copper CAT6 UTP Data Cable.
 - a. Cable shall meet the following minimum requirements:
 - 1) Support for Power-over-ethernet including:
 - a) IEEE 802.3AF (POE).
 - b) IEEE 802.3AT (POE+).
 - c) IEEE 802.3BT (POE++ 60W).

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- b. Cable shall be four (4) pair copper unshielded twisted pair cable 23 gauge copper.
 - c. Cable shall exceed Cat 6 performance requirements and have guaranteed performance to 400MHz.
 - d. Certified to UL Category 6.
 - e. Certified to ANSI/TIA Category 6 specifications.
 - f. Shall meet ANSI/TIA-568-C.2–2009+A1:2010, Balanced Twisted-Pair Telecommunications Cabling and Components Standard, and current performance specifications for Category 6 rated cable.
 - g. The cable shall have surface markings: Verified UL Category 6.
 - h. Cable color: Continuous green jacket.
 - i. Plenum rating: Where required cable shall be plenum rated and marked CMP or Plenum (UL) and meet UL-910 standards.
 - j. Cable may be non-plenum rated where installed in non-plenum spaces/areas.
 - k. Basis of Design: Superior Essex DataGain, Category 6 4 pair UTP cable.
 - l. Approved Substitution:
 - 1) Mohawk - 6 LAN Plus.
 - 2) Berk-Tek – Lanmark 1000.
6. Horizontal Copper CAT6A STP Data Cable.
- a. Cable shall meet the following minimum requirements:
 - 1) Shall meet or exceed Category 6A rating for all components including but not limited to specifications within this document and as follows:
 - a) IEEE 802.3AF (POE).
 - b) IEEE 802.3AT (POE+).
 - c) IEEE 802.3BT (POE++ 60W).
 - 2) Cable shall be four (4) pair copper shielded twisted pair cable 23 gauge copper.
 - 3) Certified to UL Category 6A.
 - 4) Certified to ANSI/TIA Category 6A specifications.
 - 5) Shall meet ANSI/TIA-568-C.2–2009+A1:2010, Balanced Twisted-Pair Telecommunications Cabling and Components Standard, and current performance specifications for Category 6A rated cable.
 - 6) The cable shall have surface markings: Verified UL Category 6A.
 - 7) Cable color: Continuous orange jacket.
 - 8) Plenum rating: Where required cable shall be plenum rated and marked CMP or Plenum (UL) and meet UL-910 standards.
 - 9) Cable may be non-plenum rated where installed in non-plenum spaces/areas.
 - 10) Basis of Design: Superior Essex 10Gain, Category 6A 4 pair STP cable.
 - 11) Approved Substitution:
 - a) Mohawk – GigaLAN 10.
 - b) Berk-Tek -- LANmark-10G2.
7. Horizontal Fiber Optic Cabling:
- a. Horizontal Fiber Optic Cable shall be Single Mode.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- b. Refer to drawings for fiber strand count as specified.
- c. Cables that provide additional fibers to replace defective fibers in the cable shall not be permitted.
- d. Single-Mode Fiber Optic cable shall:
 - 1) Be single mode 9 micron core diameter/125 micron cladding diameter.
 - 2) Meet all applicable specifications for FDDI physical media.
 - 3) Fiber used in cable shall:
 - a) Support applications using a bandwidth in excess of 1 GHz.
 - b) Meet ANSI/TIA 492 AAAA standard.
 - 4) Interior building cables shall be tight buffered, non-gel-filled design.
 - 5) Cable shall be plenum rated and marked OFNP (UL) and meet UL-910 standards.
 - 6) Cable may be non-plenum rated where installed in non-plenum spaces/areas.
 - 7) Cable used for multi-story building risers must be marked OFNR (UL) and meet UL 1666 flame test or be plenum cable as specified above.
 - 8) Underground and exterior cables shall be loose tube, gel-filled design.
 - 9) Loose Tube, gel-filled cables shall be cleaned and terminated according to Cable Manufacturer and specifications within this document.
 - 10) The use of fan-out kits shall be required. The use of splice cases shall include splice trays.
 - 11) Horizontal single-mode cable basis of design: Corning.
 - 12) Acceptable substitution:
 - a) AFL.
 - b) Prysmian.
- 8. Horizontal Copper CAT6A UTP Data Cable.
 - e. Cable shall meet the following minimum requirements:
 - 1) Shall meet or exceed Category 6A rating for all components including but not limited to specifications within this document and as follows:
 - a) IEEE 802.3AF (POE).
 - b) IEEE 802.3AT (POE+).
 - c) IEEE 802.3BT (POE++ 60W).
 - 2) Cable shall be four (4) pair copper unshielded twisted pair cable 23 gauge copper.
 - 3) Certified to UL Category 6A.
 - 4) Certified to ANSI/TIA Category 6A specifications.
 - 5) Shall meet ANSI/TIA-568-C.2-2009+A1:2010, Balanced Twisted-Pair Telecommunications Cabling and Components Standard, and current performance specifications for Category 6A rated cable.
 - 6) The cable shall have surface markings: Verified UL Category 6A.
 - 7) Cable color: Continuous orange jacket.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- 8) Plenum rating: Where required cable shall be plenum rated and marked CMP or Plenum (UL) and meet UL-910 standards.
 - 9) Cable may be non-plenum rated where installed in non-plenum spaces/areas.
 - 10) Basis of Design: Superior Essex 10Gain, Category 6A 4 pair UTP cable.
 - 11) Approved Substitution:
 - a) Mohawk – GigaLAN 10.
 - b) Berk-Tek.
- E. Lightning / Surge Suppression for Horizontal Copper Cables:
1. Lightning protection assembly shall be comprised of Chassis and Modules and shall be provided for all cabling terminating outside the building envelope or otherwise susceptible to surge.
 2. Chassis shall be installed directly above or below the patch panel being protected.
 3. Surge Protection Chassis:
 - a. Shall be high density, min ports per RU shall be 24.
 - b. All modules shall be serviceable from the front.
 - c. Modules shall be individual and field replaceable.
 - d. Chassis Basis of Design: APC #PRM24.
 4. Surge Protection Modules:
 - a. Modules shall be selected based on CATx cable being protected and/or signal type.
 - b. Modules shall be POE compliant and shall match required POE power requirement of cable being protected (30W, 60W or 100W).
 - c. Model Basis of Design: APC #PNETR6.
- F. Patch Cables:
1. Provide factory assembled patch cords sized to routing requirements.
 2. Additional patch cable for specialty systems and equipment shall be provided as required to facilitate a complete and operational system.
 3. Patch cords shall be constructed and provided by the same manufacturer that provided the data patch panels/termination hardware.
 4. Patch cable shall match color and performance specifications of corresponding horizontal cable.

2.10 BACKBONE CABLING AND TERMINATION – FIBER OPTIC CABLE

- A. Termination:
1. No service loops shall be permitted in overhead ladder rack for backbone cable.
 2. Rack Mounted Modular Fiber Optic Patch Panels – Light Interface Unit (LIU):
 - a. LIU shall be stackable, with modular connector bulkhead panels.
 - b. Single Mode bulkhead connectors shall be designed strictly for single mode fiber.
 - c. Multi-mode fiber bulkhead connectors shall be designed strictly for multi-mode fiber use.
 - d. No high density panels will be allowed.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- e. Other sizes' fiber connector bulkheads shall be designed for specified fiber size and type only.
 - f. Side or rear cable entry.
 - g. Storage area designed internally to neatly store slack cable.
 - h. Hinge out patch/connector panels.
 - i. Each connector to have covers: single-mode shall be yellow, multi-mode shall be black.
 - j. Patch panel to consist of connectors as indicated on the project drawings:
 - 1) LIU bulkhead connectors shall be ST.
 - 2) .
 - 3) South Terminal 400/800 MHz DAS shall have LC-APC LIU bulkhead connectors in IDF Rooms and fusion splices at MDF Rooms and other locations between IDF Rooms and the 400/800 MHz DAS Headend location.
 - 4) LIUs shall have a metal frame door with pad locking hinged front cover.
 - 5) LIU's shall have metal pad locking rear cover.
 - k. Provide a clear separation between horizontal and backbone fiber optic cables. Backbone fiber shall be in separate LIUs than horizontal fiber.
 - l. Provide a clear separation between multi-mode and single-mode fiber optic cables, terminate in grouped connector panels segmented by cable type.
 - m. When splice trays are required for termination of fiber they shall be of same manufacturer as LIU and have brackets / provisions to securely and neatly stack inside the rear compartment of the LIU. Trays shall be installed to allow future work in LIU and serviceability of fiber cable.
 - n. Provide with all required cable management and accessories for a complete installation.
 - o. Terminate all fiber cable with factory terminated pigtail assembly; splices shall be made in splice tray. Refer to additional Splice trays requirements below.
 - p. Basis of Design: Optical Cable Corporation RTC-LM Series.
 - q. Approved Substitution:
 - 1) None.
3. Fiber Splice Trays:
- a. Install fan out kits and splice trays where incoming or outgoing fiber optic cables are loose tube, gel-filled type OSP cables. All loose tube, gel-filled, OSP cables shall be spliced to pigtails prior to connection to patch panel.
 - b. Fiber cable splice trays shall be used for all fiber cable terminations requiring spliced pigtails.
 - c. Splice cases installed without splice trays designed are prohibited.
 - d. Splice trays shall be tray type.
 - e. Splice trays shall be provided by same manufacture as LIU(s) installed.
 - f. All splices in tray shall be fusion type.

B. Intra-Building Backbone/Riser Fiber Optic Cable:

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

1. Intra Building cable shall be used where cable is not required to leave the building or be installed below grade.
 2. Intra-Building backbone/riser fiber optic cable shall be Single Mode.
 3. Refer to drawings for fiber strand count as specified.
 4. Cables that provide additional fibers to replace defective fibers in the cable shall not be permitted.
 5. Single Mode Fiber Optic Cable Requirements:
 - a. Single mode 9 micron core diameter/125 micron cladding diameter.
 - b. Meet all applicable specifications for FDDI physical media.
 - c. Fiber used in cable shall:
 - 1) Support applications using a bandwidth in excess of 10 Gbps.
 - 2) Meet EIA/TIA 492 AAAA standard.
 - d. Interior building cables shall be tight buffered, non-gel-filled design.
 - e. Cable shall be plenum rated and marked OFNP (UL) and meet UL-910 standards.
 - f. Cable may be non-plenum rated where installed in non-plenum spaces/areas.
 - g. Cable used for multi-story building risers must be marked OFNR (UL) and meet UL 1666 flame test or be plenum cable as specified above.
 - h. Terminate tight buffer cables at connector panels with pre-terminated factory pig tail assemblies. Provide splice tray inside LIU for splice between building cable and pigtail assembly provide service loop in splice tray cable management area for maintenance and service.
 - i. Backbone single mode cable basis of design: Corning.
 - j. Acceptable substitution:
 - 1) AFL.
 - 2) Prysmian.
- C. Inter-Building Backbone/Riser Fiber Optic Cable (OSP):
1. Inter Building cable shall be used where cable is required to leave the building or be installed below grade or in wet location.
 2. Backbone/Riser Inter-Building Fiber Optic Cable shall be Single-mode.
 3. Refer to drawings for fiber strand count as specified.
 4. Cables that provide additional fibers to replace defective fibers in the cable shall not be permitted.
 5. Single-Mode Fiber Optic Cable Requirements:
 - a. Single mode 9 micron core diameter/125 micron cladding diameter.
 - b. Meet all applicable specifications for FDDI physical media.
 - c. Fiber used in cable shall:
 - 1) Support applications using a bandwidth in excess of 10 Gbps.
 - 2) Meet EIA/TIA 492 AAAA standard.
 - d. Underground and exterior cables shall be loose tube, gel-filled design.
 - e. Loose Tube, gel-filled cables shall be Loose Tube, gel-filled cables shall be cleaned and terminated according to Cable Manufacturer and specifications within this document. The use of fan-out kits are required. The use of splice cases shall include splice trays.
 - f. Backbone single mode OSP cable basis of design: Corning.
 - g. Acceptable substitution:

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- 1) AFL.
- 2) Prysmian.

D. Patch Cables:

1. Patch cables shall be provided in communications rooms for each LIU panel termination, length shall be as required to reach any LAN switch, active electronic device, and/or cabinet in same communications room.
2. The fiber optic cladding shall be covered by aramid yarn and an OFNR jacket. Specialty use patch cords shall have a jacket suitable for intended use.
3. Provided factory assembled patch cords with SC or LCAPC style connectors, coordinated with LIU connector types, with ceramic ferrules length as required for routing.
4. Provide one (1) duplex patch cord for each Fiber Optic Patch Panel termination pair. Refer to Spare Material for additional information.
5. Patch cords shall be constructed and provided by the same manufacturer that provided the fiber patch panels/termination hardware.
6. Patch cable shall match color and performance specifications of corresponding backbone cable.
7. Patch cables shall be provided by the contractor.

2.11 ZONE ENCLOSURE

- A. Description: Wall-mounted cabinets manufactured from steel sheet. Maximum equipment weight of 100 lb (45.4 kg) when secured to the structural wall with standard anchors.
- B. Equipment Mounting Rails: Two pairs of equipment mounting rails shall provide 6U of rack-mount space.
- C. Front Door: Solid and keyed.
- D. Sides: Louvered near the top for inlet airflow with four 3/4 inch and 1-1/2 inch conduit knockouts for network cable access.
- E. Bottom Panel: Vented for an exhaust fan with two 3/4 inch and 1-1/2 inch conduit knockouts for network cable access.
- F. Top Panel: Solid removable top panel to provide access to internal equipment.
- G. Rear Panel: 4 inches by 6 inches opening located near the bottom center of the cabinet for through-the-wall network cable access.
- H. Electrical Connection: Single-gang 2 inch by 4 inch duplex electrical junction box for a single duplex electrical outlet
- I. Color: Powder coat Black.
- J. Accessories:
 1. Fan Kit: Solid state temperature control variable fan speed with a 115 VAC, 60 Hz to 12 VDC power supply.
 - a. Size: 4U, 65 CFM – 120 CFM (110 CMH – 204 CMH).
 2. Power Outlet: Surge-suppressed duplex receptacle rated for 125 Volt, 15 Amps with two NEMA 5-15R outlets.
 3. Fiber Slack Manager Panel: 19 inches wide rack-mount, 4U high and 2

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

inches deep in black.

- K. Accessibility: Zone enclosures shall be mounted so as to be accessible for maintenance without requiring the use of a step ladder or lift. Ceiling-mounted zone enclosures shall be unacceptable. Refer to specification section 27 05 00 for additional information regarding accessibility of equipment.
1. Acceptable Manufacturers Chatsworth (CPI) – Thinline II
 2. Middle Atlantic – HDR
 3. Hubbell – ReBox
 4. Or approved equal.

PART 3– EXECUTION

3.1 COORDINATION

- A. Refer to Specification Section 27 05 00 for requirements.

3.2 EQUIPMENT PROTECTION

- A. Refer to Specification Section 27 05 00 for requirements.

3.3 WORK PERFORMANCE

- A. Refer to Specification Section 27 05 00 for requirements.

3.4 EQUIPMENT INSTALLATION

- A. Refer to Specification Section 27 05 00 in addition to the following.
- B. General Installation Requirements:
1. Provide any necessary screws, anchors, clamps, Velcro ties, raceway, grounding or other support hardware required to facilitate the proper installation of the Premise Distribution System.
 2. All cable, terminating hardware, cabinets, racks, and all PDS components shall include additional accessories such as clamps, supports, mounting hardware, straps, anchoring structures, termination hardware, etc. necessary to provide an industry standard installation in intended environments. Accessories include but are not limited to specifications within this document section.
 3. Locate, install, and test the Premise Distribution System in accordance with the equipment manufacturer's written instructions; the latest editions of the National Electrical Code; the National Electrical Contractors' Association publication "Standard of Installation," according to Regulatory and Reference Documents section of this document, and all applicable codes and standards referenced in this specification.
 4. Furnish any special installation equipment or tools necessary to properly complete the Work. This may include, but not be limited to, testing equipment, communication devices, jack stands, cable winches, etc.
 - a. Furnish to the Owner any specialty hand tools needed to access any covers, access hatches, or other Contractor installed enclosures.
 - b. Provide above hand tools by Substantial Completion Inspection or earlier if deemed necessary by Owner or Project Manager.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- c. Label all Comm Room outer doors "Communication Room ###" per GOAA door labeling standards for Electrical Rooms.
5. Install equipment, cables, raceways and outlets as required to comply with all applicable requirements within this specification document as minimum installation requirements. Exceed this minimum requirement when called for herein or as required to ensure a fully operational PDS.
6. Install all electrical basic materials per applicable sections of these specifications.
7. Install all rack mountable equipment in equipment rack, except that furnished and installed by GOAA and GOAA Vendors.
8. Install system cabinets/racks in locations shown; arrange to provide adequate cooling, ventilation and access.
9. Properly bond system per applicable sections of these specifications.
10. Support raceways, backboards, and cabinets under the provisions of these specifications and as required by manufacturer's instructions.
11. Install raceways and pathways to conform to applicable sections of these specifications.
12. Install PDS system wiring and raceways away from any surface that may become hot, including and not limited to, hot water piping and heating ducts.
13. Install PDS system wiring with at least 12 inches of separation from line voltage power wiring on parallel runs. Wiring crossing power circuits shall be at right angles. For metal enclosed electric light or power or Class 1 circuits, separation may be reduced as described in NEC 800-52 (a) (1). Increase separation if so required to comply with ANSI/TIA referenced standards.
14. Maintain proper separation between PDS system cables and all power and unshielded cables, as required to prevent noise, crosstalk, etc.
15. All horizontal voice and data cables shall be splice-free and homerun to the patch panel in the associated GOAA Telecommunications Room or zone enclosure as shown on the drawings.

3.5 EQUIPMENT RACKS/CABINETS:

- A. Equipment Racks/Cabinets shall be installed where shown on the drawings and in accordance with the manufacturer's instructions.
- B. Whether or not specifically shown on the drawings, all racks will be installed as specified within this document as GOAA Standard Rack/Cabinet configuration.
 1. Each equipment rack shall have one full-length vertical wire manager installed on each side of the equipment rack.
 2. Each row of terminating frames and cable racks shall be bonded to ground with a minimum #6 stranded THHN copper cable with a continuous green jacket.
 3. Remove paint from grounding lug attachment points on each rack. Each grounding lug to be attached to rack via nut and bolt method.
 - a. Bonding cables within Communications Room to be installed separate route from all horizontal and backbone cabling, back to Telecommunications Grounding Busbar.
 - b. This separate pathway shall hang from ladder rack.
 4. When mounting any equipment in enclosure, provide width, height, hardware,

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- etc. as required for complete and coordinated installation.
5. Horizontal wire managers are to be installed qty (1) for each 24 ports of modular copper cable patch panels.
 6. For the maximum size allowed patch panel (48 ports) one horizontal wire manager to be installed above and one horizontal wire manager to be installed below.

3.6 TELECOMMUNICATION OUTLETS (TO)

- A. Refer to Specification Section 27 05 00 in addition to the following.
- B. Install cable to outlets for PDS where indicated on the drawings.
- C. Install per applicable section of these specifications (i.e., outlet boxes, indoor service poles, floor boxes, wall phones, etc.).
- D. Terminate all voice, data, and fiber optic cable on jacks wired per jack wiring details in Attachment One.
- E. Install face plate on single-gang sheet rock ring. Label face plate per Attachment One.
- F. All required cabling, outlet and faceplate labeling shall be completed at the time of installation.
- G. All cable testing shall be complete before any cabling is put into use.

3.7 PATHWAYS

- A. Refer to Specification Section 27 05 00 in addition to the following.
- B. General:
 1. All raceways shall meet the applicable requirements of all of Divisions 26, 27, 28 Specifications, and all requirements within this specification document.
 2. All raceways at terminal boards shall turn 90 degrees down and terminate at a point within 6 inches of termination board with appropriate plastic bushing, and grounding hardware.
 3. Raceway shall not be shared by power or any other electrical wiring that is not part of the low voltage PDS systems. PDS system cabling may be installed in underground pull boxes with other low-voltage systems provided:
 - a. Installation meets/complies with all applicable codes and standards.
 - b. PDS system cables shall be separated by at least 12 inches from any non-shielded wire/cable.
 4. Raceway Bends:
 - a. Bend raceway with minimum inside radius of 6 times the internal diameter.
 - b. Increase bend radius to 10 times for raceway larger than 2 inch size. Provide proper bend for all changes of direction.
 - c. Pull and splice boxes shall not be used in lieu of a direction change in raceway.
 - d. Install raceways so no more than 180-degrees of total bend are present between any two pull points in any raceway section without pull box.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- 1) Install additional pull boxes as required to maintain maximum of 180-degrees in total bend between pull boxes and/or termination points.
 - 2) Label all raceway at both ends to indicate destination and PDS source room.
 - a) Length of raceway and labeling/identification shall be fully documented in as-built drawings.
 - b) As-built conduit/raceway marking nomenclature shall match exactly Identification Label format according to GOAA Standard Voice and Data Infrastructure Cable and Pathways Labeling Format document
 - c) Label PDS Conduits per GOAA Standard Voice and Data Infrastructure Cable and Pathways Labeling Format document.
 - 3) Install polyester pull cord/pull tape in each conduit whether used or empty.
 5. Pathways/raceways at terminal board locations shall be racked on a c-channel / strut channel (e.g. Unistrut / Kindorf) type rack secured to wall above and below terminal boards.
- C. Penetrations/Fire Stop:
1. Make no penetration in floors, walls or ceilings without the prior consent of the Authority/OAR. It is the responsibility of the Contractor to firestop all rated walls, penetrations, and conduits affected to code compliant condition.
 2. Where penetrations through acoustical walls or other walls for cable-ways have been provided, such penetrations shall be sealed in compliance with applicable code requirements and the Contract Documents.
 3. Where penetrations through fire-rated walls for cableways have been provided, such penetrations shall be as required by code and the Contract Documents. Submit details of any special systems to be used.
 4. Where conduit penetrates a fire rated wall, floor, etc., firestopping shall be provided and installed.
 5. Provide permanent firestopping seals after cable installers have pulled risers and distribution cables.
 6. Meet all requirements for UL assembly involved. Provide firestopping UL listed for assembly, conduit, and/or cable involved.
- D. Sleeves:
1. Install rigid steel conduit sleeves with bushings on both ends at penetration of all walls above ceilings. Stub-out each side of wall a minimum of 8 inches or as per design.
 2. Install firestopping at sleeves and all rated firewall/smoke wall penetrations. Stub-out wall as required for routing. Firestopping assembly must comply with UL for wall routing, material and cable used.
 3. Size sleeves as required by the NEC for cable installed, but in no case shall sleeve be less than 2 inch diameter, nor smaller than that required by "4)" below.
 4. Sleeve size shall not be smaller than that required by ANSI/TIA-569, Table 4.1-1, "Conduit Sizing."

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- E. Cable Support:
 - 1. Cable shall be supported in raceways according to this specification document.
- F. Termination Locations:
 - 1. Install vertical wireway to point within six (6) inches of each side of ceiling to facilitate ceiling penetrations.
 - 2. Size wireway as required for cables and meet percent fill requirements of applicable codes/standards.
 - 3. Provide bushings on each end of wireway, including grounding hardware, ground.
- G. Telecommunication Outlet (TO) Horizontal Pathway:
 - 1. Minimum size to be 1" C. Increase size of raceway to properly accommodate number of cables.
- H. Backbone Conduit and Pathways (Intra-building or Inter-building):
 - 1. Install raceways as required above under "General."
 - 2. Minimum size: 2" C.
 - 3. Increase size of conduit/raceway/pathway called for above if larger size is called for on drawings or larger size is required.
 - 4. Conduit/raceway/pathway size shall not be smaller than that required by ANSI/TIA-569, Table 5.2-1, "Conduit Fill for Backbone Cable." Conduit size shall be based on type of cable and quantity of cables.
 - 5. Install per applicable sections of these specifications and all applicable codes/standards.
- I. Pull-boxes, Splice (Junction) Boxes, Outlet Boxes, Termination Enclosures:
 - 1. Boxes shall be placed above accessible ceilings and in an exposed manner and location, and readily accessible. Boxes shall not be placed in a fixed false ceiling space unless immediately above a suitably marked and rated hinged access panel.
 - 2. Where cables can be exposed in pull boxes, label the cables per the GOAA Labeling Plan.
 - 3. All pull boxes installed to serve more than two 1" conduits shall be labeled and marked on as-built drawings.
 - 4. All backbone and horizontal pathways (no exception unless in writing from Owner) pull boxes shall be placed in conduit run where:
 - a. The length is over 100 feet.
 - b. Total of all bends exceeds 180 degrees.
 - c. There is a reverse bend.
 - d. Boxes shall be placed in a straight section of conduit and not used in lieu of a bend.
 - 1) Every pull box shall have a hinged cover:
 - a) Install appropriate access panel to allow cover to open.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- b) No backbone cabling shall rest on hinged cover when cover is closed. All cable shall have its own service loop coil support. No stick-on cable anchors are allowed.
 - 2) The corresponding conduit ends shall be aligned with each other.
 - 3) Conduit fittings shall not be used in place of pull boxes.
 - 4) Backbone cable pull-boxes shall have kindorf strut or equivalent secured to inside top to support cables' service loops.
 - 5) No cable is to be supported by or strapped to another.
- J. Horizontal Conduit and Pathways:
- 1. Size: Minimum pathway size to be 1" C.
 - 2. Flexible conduit is not allowed.
 - 3. Conduit type for location within Airport Property is per GOAA requirements, Codes, and Regulatory and Reference documents specified within this document.
 - 4. Outlet boxes shall be installed at locations shown on drawings per applicable codes/standards.
 - 5. Where a pull box is required with raceway(s) smaller than 1-1/4 trade size, an outlet box may be used as a pull box.
 - 6. Where a pull box is used with raceway(s) of 1-1/4 trade size or larger, the pull box shall:
 - a. For straight pull through, have a length of at least 8 times the trade size diameter of the largest raceway.
 - b. Have a distance between the nearest edges of each raceway entry enclosing the same conductor of at least: six times the trade size diameter of the raceway; or six times the trade size diameter of the larger raceway if they are of different sizes.
 - c. For a raceway entering the wall of a pullbox opposite to a removable cover, have a distance from the wall to the cover of not less than the trade size diameter of the largest raceway plus 6 times the diameter of the largest conductor.
 - 7. Where a splice box is used with raceway, it shall be sized per ANSI/TIA-569, Table 4.4-2, "Splice Box Sizing".
 - 8. No box shall be smaller than that required by NEC 370-28 (a), (1) and (2).

3.8 TERMINATION BACKBOARDS

- A. Terminal Boards:
- 1. Terminal boards shall be installed secure to wall with bottom of board at 6" above floor.
 - 2. Install termination backboards plumb, and attach securely to building wall at each corner.
 - 3. Finish paint termination backboards with durable gray paint having flame spread rating of Class A prior to installation of any equipment on termination boards.
 - 4. Mark all TTBs with TTB#.

3.9 COMMUNICATIONS CABLING REQUIREMENTS

- A. Refer to Specification Section 27 05 00 in addition to the following.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- B. All cable shall include additional accessories such as clamps, supports, mounting hardware, straps, anchoring structures, termination hardware, etc. necessary to provide an industry standard installation in intended environments. Accessories to include but are not limited to specifications within this document.
- C. All cable shall be kept on reels until it is installed. Do not roll or store cable reels without an appropriate underlay and the prior approval of the OAR. Cable on reels shall be handled, loaded, unloaded and transported by approved machinery equipped specifically for these operations.
- D. Replace any cable found to be defective.
- E. Do not install any Premise Distribution System cabling alongside any power circuit or device. Premise Distribution System cabling shall not share the same raceway, channel or sleeve with electrical circuits or devices.
- F. Ensure, during installation, that the maximum pulling tensions and bend radii of the Premise Distribution System cabling (both backbone and horizontal) are not exceeded.
- G. Install cables in accordance with manufacturer's instructions and ANSI/TIA 568.
- H. All cables shall be installed as illustrated on the drawings except where necessary to avoid EMI sources or other obstacles.
 - 1. The Authority/OAR must approve major deviations from the illustrated path in advance.
 - 2. No splices unless specifically noted otherwise.
 - 3. Provide adequate cable size and length for each backbone/riser run.
 - 4. All backbone cable shall be labeled per GOAA Standard Labeling Plan at every location where the cable could be exposed.
 - a. This includes all pull boxes and pull through locations.
 - 5. Provide and install riser/backbone cable that meets performance requirements specified, and links all systems room locations indicated on Contract Documents.
 - 6. Spare Cable (During Installation):
 - a. The following spare cable lengths are to be left at termination ends of conduits after termination is completed:
 - 1) Main Distribution Frame (MDF) Rooms: Fiber and copper cables terminating MDF Rooms shall have enough spare cable length left to be routed to any point in the room from point of entrance to the room.
 - 2) Intermediate Distribution Frame (IDF) Rooms: Fiber and copper cables terminating in the IDF Rooms shall have enough spare cable length left to be routed in industry standard workman like manner, from the point of entry into the systems room, to the farthest equipment rack or backboard, then down to the floor plus three (3) feet.
 - 7. Telecommunications Outlets: At the TO's, cables shall terminate with a minimum of twelve (12) inches of spare cable length for copper and twenty-four (24) inches of spare cable length for fiber.
 - 8. Install all cables no closer than 12" from any cable installed for Premise

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- Distribution System, power system cable/raceway, or fluorescent/ballasted light fixtures.
9. All PDS cable shall be installed in the appropriate raceway.
 10. Provide protection for exposed cables where subject to damage.
 11. All cables in systems rooms shall be routed in overhead cable ladder racks and dropped into the appropriate racks utilizing transition pans. All cables shall be properly secured to the cable tray, racks, or cabinets.
 - a. All fiber cable shall be routed in raceway specifically designed for fiber, and separate from copper cables.
 12. Cables shall be terminated to preserve wiring order consistently across all termination (jacks, patch panels, connector blocks and patch cords).
- I. Ensure consistency. Corrections shall be made at no additional cost to the Owner.
- J. Install appropriate cable to match application, i.e., plenum, riser, etc. All cables shall bear CMP and/or appropriate marking for the application in which they are installed.
- K. Cables/raceways routed through rated walls; floors and assemblies shall be routed via appropriate fireproofing system as approved by UL.
- L. Label cable per GOAA Standard Voice and Data Infrastructure Cable and Pathways Labeling Format document. This labeling/identification shall be fully documented in as-built drawings.
- M. Horizontal Cables Copper and Fiber:
1. Provide and install adequate number cables and cable lengths for each horizontal run.
 2. Horizontal cables shall be terminated on patch panels in rack(s) or fiber LIU.
 - a. Install one horizontal wire manager directly above or below every 24 ports of patch panel(s).
 - b. Terminate all cabling in designate system patch panel where applicable. (i.e. WiFi, CCTV, DS, VMS). Refer to specific labeling requirements for dedicated patch panels.
 3. Shall be labeled per GOAA Standard Voice and Data Infrastructure Cable and Pathways Labeling Format document.
 4. Horizontal cables shall be installed in a neat and orderly manner.
 5. Horizontal cables shall be dressed in MFD and IDFs without tangle or inter-wrapping.
 6. Termination of all horizontal station copper cables shall be by PDS contractor and shall be according to ANSI/TIA 568B wiring configuration, all fiber cables by termination methods specified within this document.
- N. Backbone Fiber Optic Cable:
1. Install fiber optic cable from each IDF to MDF in innerduct within conduit.
 2. Termination in respective fiber optic patch panel shall be via connectors as described in Part 2 and labeled per GOAA Standard Voice and Data Infrastructure Cable and Pathways Labeling Format document.
 3. Provide minimum 15FT feet of slack (service loop) on both ends of each fiber optic cable.
 4. Observe all manufacturer's specifications relative to cable bend radius and

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

pulling tension.

- a. All fiber cables to be installed without splices except at pigtails in LIU or at outlets.

- O. Provide adequate quantities and supporting hardware to terminate the quantity of cable pairs and fiber strands in the MDF and all IDF's as required to comply with these specifications.

3.10 ELECTRICAL POWER DISTRIBUTION

- A. Refer to Division 26 and Specification Section 27 05 00 for requirements.

3.11 TRANSIENT VOLTAGE SURGE SUPPRESSION

- A. Refer to Specification Section 27 05 00 for requirements.

3.12 GROUNDING AND BONDING

- A. Refer to Division 26 and Specification Section 27 05 00 in addition to the following.
- B. Provide and install complete bonding system as required to comply with all sections of these specifications and applicable codes and referenced standards.
- C. Connect all rows of racks and cabinets to Telecommunications Ground Bus (TGB) with AWG #6 THHN green jacket.
 - 1. Each row shall have its own ground cable as described above.
- D. Connect all horizontal and backbone metal conduit (via grounding bushing) to TGB.
- E. Connect cable shields to Rack Grounding Busbar (RGB).
- F. Connect surge suppression equipment to TGB.

3.13 EQUIPMENT IDENTIFICATION

- A. Refer to Specification Section 27 05 00 and Attachments to this section in addition to the following.
- B. Labeling – General:
 - 1. Cables, pathways, significant Junction Boxes, PDS components etc. shall be labeled at each exposed and termination point and as detailed below at the time of installation. All Unique Cable Identifiers (UCI), Unique Pathway Identifiers (UPI), Unique LIU Identifier (ULI), and similar field characters shall be provided by GOAA to the Installer for use in completing label structure field data.
 - 2. All conduit, pathways, innerducts, enclosures, pull boxes and wireways shall be labeled.
 - 3. Provide and install printed labels for all conduit, pathways, cables, patch cords, frames racks, enclosures, pull boxes etc. See Attachment One: GOAA Standard Voice and Data Infrastructure Cable and Pathways Labeling Format document.
 - 4. All labeling shall be in accordance with ANSI/TIA-606. UL and NEMA requirements.
 - 5. All physical location and network identifiers shall be derived from MCO standard GIS fields and characters.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

6. All PDS components must be easily identifiable for any person that may need to locate telecommunications equipment, facilities, or circuit information.
 7. Cable and equipment management shall be performed using PDS Administration Database program that track all telecommunications circuit components. Coordinate requirements for adding cable and equipment management information to the GOAA PDS Administration Database with GOAA.
 8. All copper and fiber test results must be exportable into format to allow importing into Telecommunications PDS Administration Database.
 9. Hand written labels shall not be acceptable.
- C. Patch Panels:
1. Provide Permanente phenoloc label on each “dedicated patch panels” located in the upper left hand side indicating patch panel designation, system designation, and warning; see below example:
 - a. PP-01 CCTV ONLY (PP-xx yyyy ONLY) x=patch panel number, y=System type.
- D. Racks / Cabinets:
1. All Racks and cabinets shall have phenolic label mounted to the top of each rack or cabinet.
 2. Labels shall be $\frac{3}{4}$ " MIN letters and White lettering on black label.
- E. Telecommunication Outlets (TOs):
1. All Telecommunication Outlets (TO) are to be labeled (with appropriate designation labels per GOAA Standard Voice and Data Infrastructure Cable and Pathways Labeling Format document see Attachment One for details.
- F. Cables and Pathways:
1. Cables that shall be labeled include but are not limited to backbone, horizontal, patch cords, line cords, and jumpers.
 2. Labels shall be installed for all pathway and cable so they are visible and able to be read by a person standing on floor without moving cables, and if conduit/pathway, labels shall not be obscured by other conduit, or components. Any additional types of labeling materials necessary to keep labels visible shall be provided by the Contractor and installed by the Contractor.
 3. All installed metallic and fiber patch cords shall be labeled.
 4. Pathways are defined but not limited to; any conduit, inner-duct, underground duct-bank, wiring troughs, pull boxes, and any wiring systems used to enclose cabling of any type.
 5. Any pathways or cables whose label format is not specifically mentioned in the GOAA Standard Voice and Data Infrastructure Cable and Pathways Labeling Format document shall still be labeled in a similar format as directed by GOAA OAR/Telecom.
 6. Cable and Pathway Labels shall be electronically generated by thermal transfer printer. All labels with all fields shall be delivered to GOAA electronically.
 7. Cable and Pathway Labels shall be printed in ALL CAPITAL LETTERS. All

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

components follow "End One" / "End Two" format and named for Inventory format following MCO standard GIS fields' structured labels. GOAA has the right to change field data and label structure without additional costs.

8. Cable and Pathway Labels shall be printed on adhesive tags no less than 2" in height and permanently placed, longitudinally or flagged. ALL LABELS MUST BE VISIBLE WHEN INSTALLED.
 9. Cable and Pathway Labels shall be made of polyester or similar durable material with permanent adhesive characteristics typically found in telecommunication labels. Cable labels to be self-laminating. PER-PROJECT PRODUCTS USED ONLY AFTER SUBMITTALS ARE APPROVED BY GOAA.
 10. Cable Labeling - Attached for easy access and visibility to the cable within 12" of entering the LIU or terminating at Patch Panel.
 11. Cable Labeling - Attached for easy access and visibility to the cable 12" – 16" before entering conduit or inner-duct pathway.
 12. Cable Labeling - Attached for easy access and visibility to the cable on service loop on TTB for backbone cables.
 13. When printing labels no line break shall fall in a data field. All line breaks to be after nearest field separating character.
 14. Pathway Labeling - Attached for easy access and visibility to conduit (occupied with cable or inner-duct). Shall be visible without movement.
 15. Pathway Labeling - Attached for easy access and visibility to inner-duct (empty or occupied with cable) 12" – 16" before inner-duct enters conduit pathway.
 16. Inner-duct and cables shall be labeled any time the inner-duct or cable is/can be exposed i.e. pull/junction boxes, manholes, and similar conditions.
 17. Inner-ducts and cables shall be labeled in all pull-boxes, manholes, junction boxes. Labels to be minimum 4IN x 2IN, rated for outdoor use and permanently secured by one tie wrap at each end of label or as approved by GOAA.
- G. The labeling scheme is to enable tracing data/circuit information flow between devices without physically tracing each cable, and will be used to identify the following communications infrastructure components and paths:
1. Where any active Electronic Systems are installed by any party requiring use of new or existing fiber or copper backbone or horizontal cables, the installation of fiber or copper patch cords shall be complete; all patch cords shall be permanently and properly routed in the pathway created for same, and the patch cords shall be labeled on each end with source/destination according to GOAA Labeling Specifications. All patch panel or LIU User Identification tables shall be filled out as to use/user. This must be demonstrated as complete by Substantial Completion inspection.
 2. Each active device and its rack location.
 3. Each patch panel, row and the associated active device.
 4. Each active device cable and the device it is attached to at the other end.
 5. Each dormant cable and its other end.
 6. Each systems room cable and the systems room located at the other end.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- H. All horizontal media (cable) shall be labeled at both ends indicating exact origination and destination information, using basis of design labeling method.
- I. Any patch cords installed in MDFs, IDF, or other rooms shall be labeled according to GOAA Format as provided by GOAA Information Technology Department at both ends.
- J. Telecommunications Infrastructure Administration Records:
 - 1. Example Telecommunications Infrastructure Administration Records tables shall be provided by GOAA Information Technology Department.
 - 2. Installing Contractor shall complete all infrastructure element labeling and Telecommunications Infrastructure Administration Records tables/forms.
 - 3. Above forms shall be submitted filled out by installing Contractor in their entirety prior to Project Substantial Completion, at the same time all cable test records are submitted.
 - a. Tables shall be submitted in Hardcopy and electronic format.
 - 1) Hardcopy to be submitted in 3 ring binder at same time as cable test records.
 - 2) Electronic file to be submitted in Excel most current version using Arial 10 font size using layout in example provided by GOAA.

3.14 MAINTENANCE AND SERVICE

- A. Refer to Specification Section 27 05 00 for requirements.

3.15 WARRANTY

- A. Refer to Specification Section 27 05 00 for requirements.

3.16 FIELD SERVICES

- A. Refer to Specification Section 27 05 00 in addition to the following.
- B. No fiber optic or copper cable shall be put into use without being successfully tested and the test results approved as submitted to the Authority and OAR.
- C. Perform all testing where necessary or specified to assure a fully functional system. Repair or replace and retest components that fail performance standards.
- D. Test all cables:
 - 1. Provide all cable test results in electronic formate.
 - 2. Test instrument data fields shall exactly match PDS component labeling, I.E. Telecommunication Outlets, fiber LIUs, etc., provide exact source/destination information for all media tested.
 - 3. All horizontal copper voice and data cable test results shall be together in a submittal, with each Telecommunication Outlet's test results pages together and sequential.
 - 4. Submittalshall have Installing/Testing Contractors company information and warranty phone numbers to call for service.
- E. Provide system verification and acceptance documentation signed and dated by the installer.
 - 1. This documentation shall include test measurements and system calibrations

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- performed for the entire system.
 - 2. Sample system operations shall also be performed with actual hardware or using Contractor provided test equipment and documented to verify that the system is operational and ready for acceptance.
 - 3. This shall also establish the baseline performance of the system.
- F. Fiber Optic Cable Testing:
- 1. Each fiber in every backbone inter-building and intra-building cable and every horizontal cable run shall undergo Tier 1 and Tier 2 testing as described in ANSI/TIA-568-D, including an Attenuation Test and an Optical Time Domain Reflectometer (OTDR) test.
 - 2. Test results shall include a record of:
 - a. Wavelength.
 - b. Fiber type.
 - c. Fiber and cable number.
 - d. Measurement direction.
 - e. Test equipment model and serial numbers
 - f. Date.
 - g. Reference setup.
 - h. Operator (crew members).
- G. Copper Category 6 or higher, UTP & STP Cable Testing:
- 1. Every cable and connector pin for each horizontal cable run from an MDF or IDF to a Telecommunication Outlet (TO) shall be tested up to 250 MHz for Category 6 rated operation:
 - a. Continuity on each pin.
 - b. Correct pin-pair orientation (wiremap).
 - c. Propagation Delay (100 m).
 - d. Skew (100 m).
 - e. Near end crosstalk (NEXT value).
 - f. Power Sum Near End Crosstalk (PSNEXT).
 - g. dB loss (attenuation).
 - h. Equal Level Far End Crosstalk (ELFEXT).
 - i. Power Sum Equal Level Far End Crosstalk (PSELFEXT).
 - j. Return loss.
 - k. Cable length.
 - l. Presence of AC voltage.
 - m. The Category 6 cable shall be tested for the conformance to the specifications of ANSI/TIA 568-D Category 6.
 - n. Should UTP cable type in project be changed to make use of updated cable technologies, testing of cable shall conform to latest industry standard and manufacturer's testing requirements to ensure cable has been correctly installed and is operating to specification.
 - o. STP cabling shall include the following additional test requirements:
 - 1) Cable shield continuity
 - 2) Power Sum Alien Near-End Crosstalk (PSANEXT) test
 - 3) Power Sum Attenuation-to-Alien-Crosstalk Ratio at the Far End (PSAACRF) test

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT
ORLANDO, FLORIDA

- p. Category 6A rated cable shall include the following additional requirements:
 - 1) Perform all testing required for Category 6 rated cable up to a frequency of 500MHz for all Category 6A rated cable.

3.17 PROJECT CLOSEOUT REQUIREMENTS

- A. Refer to Specification Section 27 05 00 in addition to the following.
- B. Upon completion of the aforementioned tests and before system commissioning and final acceptance, actual voice and data testing shall be performed.
- C. The tests may be performed with existing equipment, if in place, or using contractor provided equipment or test equipment.
- D. The tests shall be performed at Owner's discretion and on a sample basis (10% of installed Telecommunication Outlets, copper pairs, and fiber strands) on various portions of the network as determined by the Authority/OAR.
 - 1. The tests shall be witnessed by the Contractor, the Authority/OAR.
- E. Demonstrate system to designated Owner personnel as required by applicable sections of these specifications.
 - 1. Conduct walking tour of project.
 - 2. Briefly describe function, operation, and maintenance of each component.
 - 3. All pull-box covers shall be removed so Owner can inspect for proper installation of cable and labels.
 - 4. Provide detailed operation and maintenance instruction and training.
 - 5. Use submitted operation and maintenance manual as reference during demonstration and training.

3.18 ATTACHMENTS

- A. Attachment 0 – General Guidelines – Labeling Cable and Pathways (1 page)
- B. Attachment 1 – MCO Information Technology Outlets (ITO) Wiring Detail REV 12
- C. Attachment 2 – Labeling Backbone Fiber Optic Cables – Data Field Definitions

END OF SECTION 27 10 00

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT

ATTACHMENT 0 - GENERAL GUIDELINES – LABELING CABLE AND PATHWAYS

The following pages outline general labeling activities for the various pieces of the GOAA Communications Infrastructure at the Orlando International Airport. Cables, pathways, significant Junction Boxes, PDS components etc. shall be labeled at each exposed and termination point and as detailed below *document not all inclusive. All Unique Cable Identifiers (UCI), Unique Pathway Identifiers (UPI), Unique LIU Identifier (ULI), and similar field characters shall be provided by GOAA to the Installer for use in completing label structure field data.

- Printer, labels, font, font size, and attachment details shall be as specified in GOAA Master Design Guidelines Infrastructure Section: Products section pertaining to approved labeling materials and methods. All physical location and network identifiers shall be derived from MCO standard GIS fields and characters.
- Cable and Pathway Labels electronically generated by thermal transfer printer. All labels with all fields shall be delivered to GOAA electronically.
- Cable and Pathway Labels printed in ALL CAPITAL LETTERS. All components follow “End One” / “End Two” format and named for Inventory format following MCO standard GIS fields’ structured labels. GOAA has the right to change field data and label structure without additional costs.
- Cable and Pathway Labels printed on adhesive tags no less than 2” in height and permanently placed, longitudinally or flagged. MUST BE VISIBLE.
- Cable and Pathway Labels made of polyester or similar durable material with permanent adhesive characteristics typically found in telecommunication labels. Cable labels to be self-laminating. PER-PROJECT PRODUCTS USED ONLY AFTER SUBMITTALS ARE APPROVED BY GOAA.
- Cable Labeling - Attached for easy access and visibility to the cable within 12” of entering the LIU or terminating at Patch Panel.
- Cable Labeling - Attached for easy access and visibility to the cable 12” – 16” before entering conduit or inner-duct pathway.
- When printing labels no line break shall fall in a data field. All line breaks to be after nearest field separating character.
- Pathway Labeling - Attached for easy access and visibility to conduit (occupied with cable or inner-duct). Shall be visible without movement.
- Pathway Labeling - Attached for easy access and visibility to inner-duct (empty or occupied with cable) 12” – 16” before inner-duct enters conduit pathway.
- Inner-duct and cables to be labeled any time the inner-duct or cable is/can be exposed i.e. pull/junction boxes, manholes, and similar conditions.
- Inner-ducts and cables to be labeled in all pull-boxes, manholes, junction boxes. Labels to be minimum 4IN x 2IN, rated for outdoor use and permanently secured by one tie wrap at each end of label or as approved by GOAA.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT

ATTACHMENT 1 – MCO INFORMATION TECHNOLOGY OUTLETS (ITO) WIRING DETAIL. REV12

THIS ATTACHMENT CONTAINS TWO DIAGRAMS;

1. WIRING / JACK DETAILS

2. FACE-PLATE LABELING DETAILS

1. Standard GOAA ITO Requirements: Each Information Technology Outlet (ITO) shall be installed with Category Cat 6 cable and hardware. All Category 6 products shall be Category 6 component compliant unless specifically noted otherwise. Each GOAA Standard Outlet is served by three (3) Cat 6 UTP cables to the local GOAA communications room and where applicable an additional three (3) Cat 6 UTP cables to local tenant communication room.
2. GOAA offices ITO requirements: GOAA office ITO shall be installed with L4, L5 and L6 cables. All cables are installed back to a GOAA Communications Room (CR) and to a rack mounted patch panel. L1, L2 and L3 are blanked. Cables may be added in location(s) per project design. If L1, L2 or L3 are added to a GOAA ITO, the bezels are to be blue.
3. Tenant ITO requirements: Tenant ITO shall be installed with *L1, *L2, *L3, L4, L5 and L6 cables. Tenant ITO shall use L1, L2 and L3 as Tenant only cables and shall be cabled to Tenant space, where typically a Tenant has assigned space within their leased locations to place their private LAN or Point of Sale (POS) network electronics.*Cables L1, L2 and L3 (all with green bezels) may be eliminated if Tenant does not require them. If an ITO is installed without cables L1, L2 or L3, blanks shall be placed in each unused faceplate positions. If Tenant requires higher "L" density, Information Technology Outlet Plus (ITOP) can be used.
4. Non-Tenant, non-GOAA office ITO requirements: such as CUTE, CUPPS, counters, bag make-up floor areas, bag make-up controllers/stations, etc.); shall be installed with L4, L5 and L6 cables. All cables are installed back to a GOAA CR and to a rack mounted patch panel. L1, L2 and L3 are blanked. If increased L densities are required, Information Technology Outlet Plus (ITOP) can be used.
5. All GOAA ITO cables shall be installed unbroken back to a GOAA CR as indicated on the drawings, or as directed by the Owner's Authorized Representative (OAR) and shall be punched down on a GOAA Information Technology patch panel mounted in an open rack. 110 blocks are not to be used for termination. Patch panel locations are to be in accordance with the rack elevations, or as directed by the OAR. All Tenant wiring shall also be installed unbroken end to end.
6. For L1, L2 and L3 jacks / cabling / associated components for Tenant Premise Distribution System (PDS) wiring that has cable staying within Tenant Space and terminated only to Tenant Equipment in Tenant Space; L1, L2 and L3 components specifications are at the Tenants discretion, however it is recommended that GOAA standards be followed.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT

7. Outlet wire management: all outlet wiring shall have cable management products installed in Work Areas and Communications Rooms; no horizontal wiring shall be self-supporting or supported by tie-wraps to other cables.
8. Cable testing: all cables / jacks installed shall be fully tested in accordance to TIA-568-C.2 and TIA 1152-A requirements by field test devices. Test results SHALL be saved and submitted to Greater Orlando Aviation Authority in a GOAA approved electronic format. GOAA reserves the right to update the electronic format without cost. Testing shall be completed after fiber and copper cabling are in place and secure. Testing shall be submitted to GOAA by Substantial Completion or prior to being put into use, whichever comes first.
9. Information Technology Outlet Plus (ITOP): in some conditions, to increase Tenant LAN jack densities, such as in training rooms, call centers, or similar, (ITOP) may be added to supplement areas served by ITOs. Such applications shall be approved in writing prior to installation. ITOPs shall supplement ITOs, not replace ITOs. Labeling Information Technology Outlet Plus (ITOP) shall follow DIAGRAM TWO in this attachment. Under counter Information Technology Outlets (ITOs) may be side access multi-media outlets in specific designs authorized by Information Technology department.
10. Information Technology Outlet Plus (ITOP): in some conditions the exact configuration of Information Technology Outlets (ITO) fiber and copper connectivity shall vary to accommodate the design intent, such as; Flight Information Displays (FIDs) monitors, Training Centers, multi-purpose kiosks, etc. It's not the intent of this Information Technology Outlet ITO configuration meet all requirements. In SPECIAL CONDITIONS refer to the Contract Documents or consults with the OAR to obtain written authorization to deviate from this ITO configuration.
11. Cables shall be in hard-wall metallic conduit following GOAA construction specifications section Division 27 or per Project written design requirements. Conduit can be trunk/branch system, following TIA / EIA conduit sizing and maximum degree of bends allowed.
12. For GOAA complete copper and fiber infrastructure design requirements and connectivity components performance specifications see GOAA Master Design Guideline sections 27 10 00 Structured Cabling.
13. Any single wall phone height telephone jacks called for shall have type Cat 6 cable and matching components, and a single position wall phone jack.

DIAGRAM ONE: REQUIRED JACK POSITIONS IN FACE PLATE

- V1 - LAN Jack 568B
- CATEGORY 6
 - RJ45
 - BLUE BEZEL

- L4 - LAN JACK 568B
- CATEGORY 6
 - RJ45
 - BLUE BEZEL

- L5 - LAN JACK 568B
- CATEGORY 6
 - RJ45
 - BLUE BEZEL

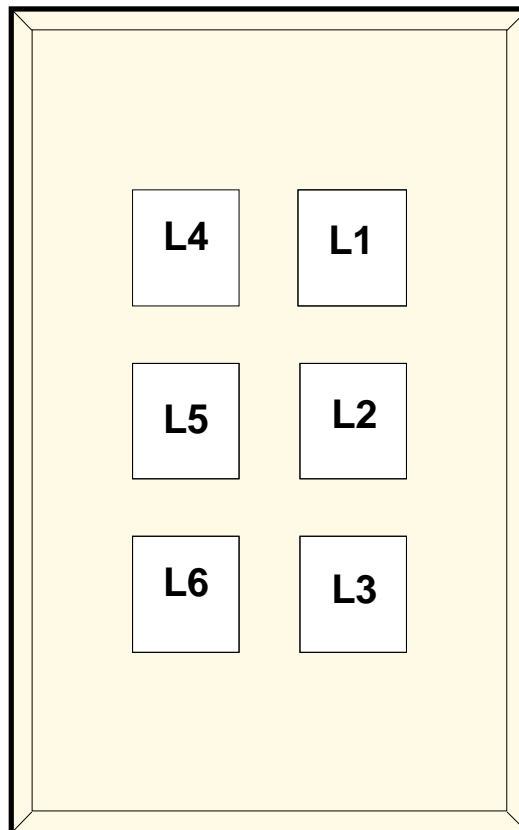


DIAGRAM TWO: LABELING OF FACE PLATE

- L1 - LAN JACK 568B
- CATEGORY 6
 - RJ45
 - GREEN BEZEL

- L2 - LAN JACK 568B
- CATEGORY 6
 - RJ45
 - GREEN BEZEL

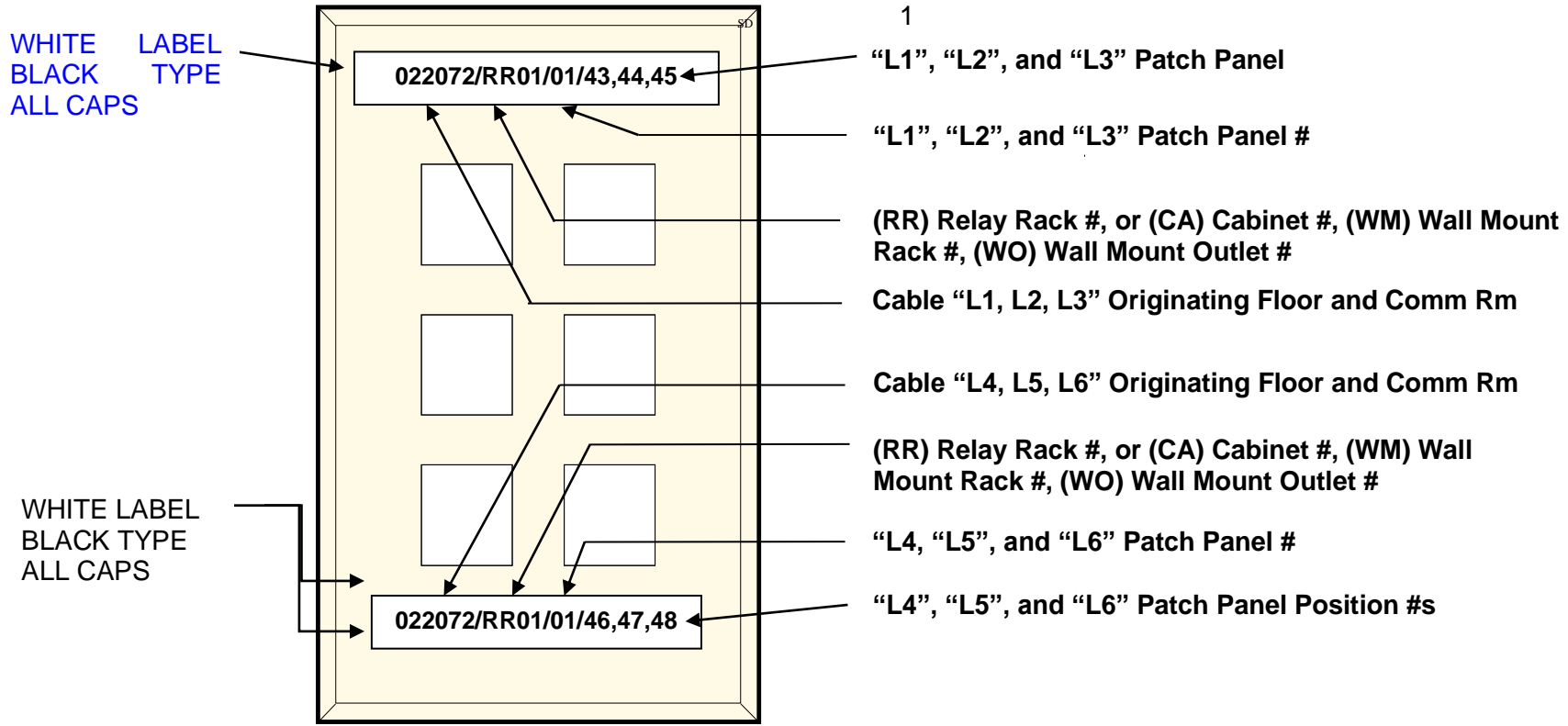
- L3 - LAN JACK 568B
- CATEGORY 6
 - RJ45
 - GREEN BEZEL

For GOAA-only spaces, L1, L2, L3 shall have blue bezel if positions are required.

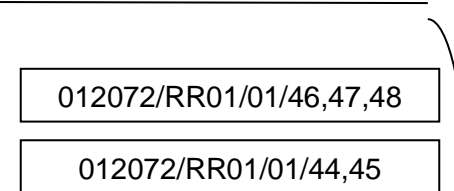
GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT

No handwritten labels are allowed. Do not remove adhesive backing from typical label printers for under lenses' labels. Insert labels under clear lens top and bottom of outlet as shown below. Do remove backing for L1 and L2 label

NOTE: All horizontal cables to be labeled behind the patch panel approx 4 inches from the termination fan-out with the room/relay rack/port clearly visible without moving cables.



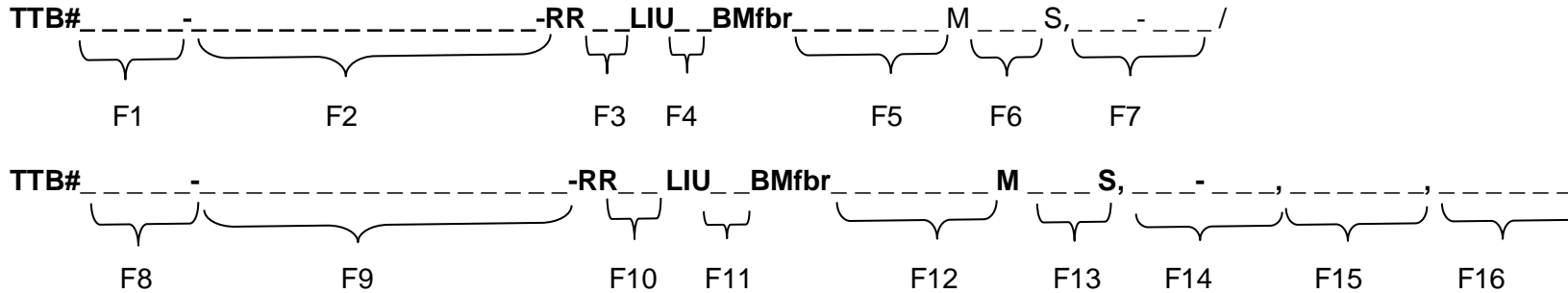
Duplicates of all three labels with adhesive backing removed to be placed side by side on the suspended ceiling metal support runner ("T bar") above the ITO. If the ceiling is higher than normal office space these labels shall be placed on millwork or other above the (ITO) or (SDO) clearly visible without moving furniture or equipment.



GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT

LABELING BACKBONE FIBER OPTIC CABLES – DATA FIELD DEFINITIONS

Physical Layer Administration - Attachment Two R3



1. Enter all characters; commas, dashes, slashes etc. exactly as shown in format and Figure 1. Match line breaks in [Figure 1](#).
2. Where fields are not completely filled left to right, enter zeroes on left of data to fill all field character spaces.
3. Print same label for all placements; do not exchange End 1 and End 2 position in label fields.
4. Complete label as shown here is required at each cable end. Place on cable, exterior to LIU within 12 inches of LIU in clearly viewable location.
5. Duplicate of label shall also be placed on LIU front panel exterior in front of bulkhead positions of cable.
6. One extra copy of each cable label shall be printed and submitted to Telecom as record, used for field QC.
7. Cable shall be tagged with 10 character UCI# in each manhole, junction box, trough, conduit exit location, and similar locations where cable may be exposed.
8. Excel table will be submitted on 3.5IN disk to Contractor for used in gathering cable information. Contractor to return same table on 3.5IN disk or CD filled out in entirety as a record document.

F1: End 1 TTB# provided by Project and/or GOAA Information Technology Department 5 characters

F2: End 1 Building-Area-Room Number (Space Designation) provided by GOAA and/or Project, 16 characters

F3: Relay Rack Number (**RR**) 2 characters. If a Cabinet is used, (**RR**) is to be replaced by (**CA**). If LIU being installed for cable is Wall Mount use (**WM**).

F4: Light Interface Unit (**LIU**) 2 characters

F5: Backbone Multi-mode (**BMFBR**), Single-Mode (**BSFBR**) or Composite (**BCFBR**) and Unique Cable Identifier (**UCI**) 4 characters. UCI provided by GOAA Information Technology Department.

F6: Fiber strand qty of each type under this one jacket. "3 characters M 3 characters S". 096M000S denotes 96MM zero SM. 072M096S denotes a Composite cable.

F7: Bulkhead Position Range 3 characters – 3 characters

F8: End 2 TTB# provided by Project and/or GOAA Information Technology Department 5 characters

F9: End 2 Building-Area -Room Number (Space Designation), provided by GOAA and/or Project, 16 characters

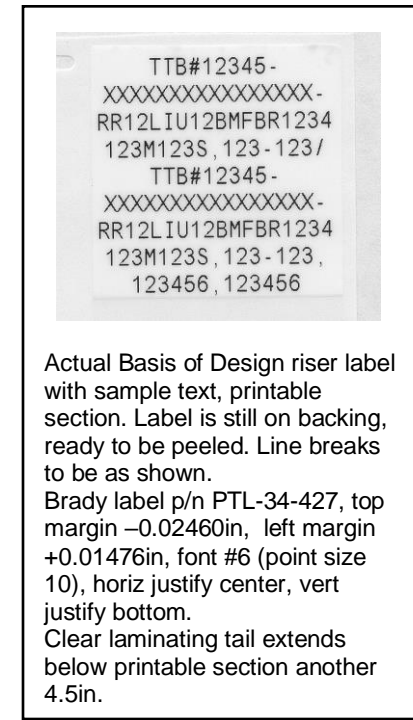
F10: Relay Rack Number (**RR**) 2 characters. If a Cabinet is used, (**RR**) is to be replaced by (**CA**). If LIU being installed for cable is **Wall Mount** use (**WM**).

F11: Lightguide Interface Unit (**LIU**) 2 characters

F12: Backbone Multimode or Single-Mode Fiber (**BMFbr**) or (**BSFbr**) Unique Cable Identifier (UCI) 4 characters. This number provided by GOAA Information Technology Department.

GREATER ORLANDO AIRPORT AUTHORITY
EMPLOYEE PARKING LOT

- F13: Fiber strand qty of each type under this one jacket. 096M000S denotes 96MM zero SM. 072M096S denotes a Composite cable. "3 characters M 3 characters S".
- F14: Bulkhead Position Range 3 characters – 3 characters
- F15: Length in feet 6 characters, no commas in number.
- F16: Date Installed 6 characters, date format to be month, day, last two digits of year; "012218".



SECTION 31 00 00 - EARTHWORK

PART I - GENERAL

1.1 DESCRIPTION

- A. Scope of Work: The work included under this Section consists of dewatering, excavating, trenching, sheeting/shoring, filling, grading, backfilling, and compacting those soil materials required for the construction of the embankments, structures, piping, ditches, utility structures and appurtenances as shown on the Drawings and specified herein.
- B. Definitions
1. Maximum Density: Maximum weight in pounds per cubic foot of a specific material as determined by ASTM D1557.
 2. Optimum Moisture Content: The optimum moisture content shall be determined by ASTM D 1557 to determine the maximum dry density for relative compaction. Field moisture content shall be determined on the basis of the fraction passing the 3/4-inch sieve.
 3. Rock Excavation: Excavation of any hard, natural substance which requires the use of explosives and/or special impact tools such as jack hammers, sledges, chisels or similar devices specifically designed for use in cutting or breaking rock, but exclusive of trench excavating machinery.
 4. Suitable: Suitable material shall be non-cohesive, non-plastic granular local sand that is free from vegetation, organic material, marl, silt or muck. The materials shall also meet detailed requirements specified herein. The Contractor shall furnish all additional fill material required.
 5. Unsuitable: Unsuitable materials are highly organic soil (peat or muck) classified as A-2-5, A-2-6, A-2-7, A-4, A-5, A-6, A-7, and A-8 in accordance with AASHTO Designation M 145.
- C. Plan for Earthwork
1. The Contractor shall be responsible for having determined to his satisfaction, prior to the submission of his bid, the conformation of the ground, the character and quality of the substrata, the types and quantities

of materials to be encountered, the nature of the groundwater conditions, the prosecution of the work, the general and local conditions and all other matters which can in any way affect the work.

2. Prior to commencing the excavation, the Contractor shall submit a plan of his proposed operations to the Engineer for review. The Contractor shall reflect the equipment and methods to be employed in the excavation. Prices established in the Proposal for the work to be done will reflect all costs pertaining to the work. No claims for extras based on substrata or groundwater table conditions will be allowed.
- D. Trench Safety Act: The Contractor shall comply with all of the requirements of the Florida Trench Safety Act (Chapter 90-96, CS/CB 2626, Laws of Florida). The Contractor shall acknowledge that included in various items of his bid proposal and in the total bid price are costs for complying with the provisions of the Act.
- E. Related Work Described Elsewhere
1. Shop Drawings, Products and Samples: Section 01 33 2, and Submittals: Section 01 33 00.
 2. Temporary Erosion and Sedimentation Control: Section 01 57 13.
 3. Clearing, Grubbing, and Stripping: Section 31 11 00.
 4. Dewatering: Section 31 23 19.
 5. Process and Utility Piping, Fittings, Valves, and Accessories: Section 15050.

1.2 APPLICABLE PUBLICATIONS

- A. All publications and standard specifications referred to herein are the latest or current issue of that publication or specification as of the specification date.

1.3 QUALITY ASSURANCE

- A. The Contractor is responsible for testing and laboratory services, and for all associated fees.

1.4 FEDERAL AND STATE REGULATORY REQUIREMENTS

- A. All trench excavations which exceed 5 feet in depth shall comply with the applicable trench safety standards as stated in the OSHA excavation safety standards 29 CFR S. 1926.650 Subpart P as regulated and administered by the Florida Department of Labor and Employment Security as the "Florida Trench Safety Act."

1.5 JOB CONDITIONS

- A. If, in the opinion of the Engineer or OAR, conditions encountered during construction warrant a change in the footing elevation, or in the depth of removal of unsuitable material from that indicated in the soils report, an adjustment will be made in the contract price.

1.6 SUBMITTALS

- A. Submit to the Engineer for review the proposed methods of construction, including dewatering, excavation, bedding, filling, compaction and backfilling for the various portions of the work. Review shall be for information only. The Contractor shall remain responsible for the adequacy and safety of the methods. Where sheeting and bracing is required for construction, the design shall be performed by a Professional Geotechnical Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General

1. All fill material from on and off-site sources shall be subject to the approval of the Engineer and OAR.
2. All fill material shall be unfrozen and free of organic material, trash, or other objectionable material. Excess or unsuitable material shall be removed from the job site by the Contractor.

B. Common Fill Material

1. Common Fill shall be sand not containing stones, rock, concrete or other rubble larger than 2 inches in diameter. No more than 10% of the material, by weight, shall pass a 200 mesh sieve and organic matter in the material shall be less than 1% by weight.
2. The Contractor shall utilize as much excavated material as possible

for reuse in accordance with the Drawings and Specifications or as directed by the Engineer.

3. The Engineer and OAR shall direct the Contractor on the type of material allowed in certain sections of the earthwork operations.

C. Select Common Fill

1. Select Common Fill material shall be free from stones larger than 1 1/2 inches and no more than 5% of the material shall pass a 200 mesh sieve. The amount of organic matter in the material shall not exceed 1% by weight.
2. The Contractor shall utilize as much excavated material as possible for reuse in accordance with the Drawings and Specifications or as directed by the Engineer.
3. The Engineer shall direct the Contractor on the type of material allowed in certain sections of the earthwork operations.

D. Structural Fill: Structural fill shall be well graded sand to gravelly sand having the following gradation:

<u>U.S. Sieve Size</u>	<u>Percent Passing By Weight</u>
1 - inch	100
No. 4	75-100
No. 40	15-80
No. 100	0-30
No. 200	0-10

E. Bedding Rock: Manufactured angular, granular material, 1/4 to 1-1/2 inches (6 to 40 mm) in size, including materials having significance such as crushed stone or rock, broken coral, crushed slag, cinders, or crushed shells. Sieve analysis for crushed stone is given below separately.

1. Crushed Stone: Crushed stone shall consist of clean mineral aggregate free from clay, loam or organic matter, conforming with ASTM C33 stone size No. 89 and with particle size limits as follows:

<u>U.S. Sieve Size</u>	<u>Percent Passing By</u>
<u>Weight</u> 1/2	100
3/8	90-100
No. 4	20-55
No. 8	5-30
No. 16	0-10
No. 50	0-5

- F. No. 57 Stone w/ associated filter fabric: No. 57 stone shall be per section 901 of FDOT's Standard Specifications, and filter fabric shall be per FDOT Index No. 199.
- G. Other Material: All other material, not specifically described, but required for proper completion of the work shall be selected by the Contractor and approved by the Engineer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clearing and grubbing shall be performed in accordance with Section 31 11 00.
- B. Protection
 - 1. Sheeting and Bracing:
 - a. Furnish, put in place, and maintain sheeting and bracing as required to support the sides of excavations, to prevent movement which could in any way diminish the width of the excavation below that necessary for proper construction, and to protect adjacent structures, and to protect workers from hazardous conditions or other damage. Such support shall consist of braced steel sheet piling, braced wood lagging and soldier beams or other approved methods. If the Owner is of the opinion that sufficient or proper supports have not been provided, he may order additional supports be installed at the expense of the Contractor, and compliance with such order shall not relieve or release the Contractor from his responsibility for the sufficiency of such supports. Care shall be taken to prevent voids beside the sheeting, but if voids are formed, they shall be immediately filled and compacted. Where soil cannot be properly compacted to fill a void, lean concrete shall be used as backfill at no additional expense to the Owner.
 - b. The Contractor shall construct sheeting outside the neat lines of the foundation unless another configuration is desirable for his method of operation. Sheeting shall be plumb and securely braced and tied in position. Sheeting and bracing shall withstand all pressure to which the structure or trench will be subjected. Any deformation shall be corrected by the Contractor at his own expense so as to provide the necessary clearances and dimensions.
 - c. Where sheeting and bracing is required for construction, the Contractor shall engage a Professional Geotechnical Engineer,

registered in the State of Florida, to design the sheeting and bracing. The sheeting and bracing installed shall conform with the design, and certification of this shall be provided by the Professional Geotechnical Engineer.

- d. The installation of sheeting, particularly by driving or vibrating, may cause distress to existing structures. The Contractor shall evaluate the potential for such distress and, if necessary, take all precautions to prevent distress of existing structures because of sheeting installation.
- e. The Contractor shall leave in place to be embedded in the backfill, all sheeting and bracing not shown on the Drawings but which the Owner directs him in writing to leave in place at any time during the progress of the work for the purpose of preventing injury to structures, utilities, or property, whether public or private. The Owner may direct that timber used for sheeting and bracing be cut off at any specified elevation.
- f. All sheeting and bracing not left in place shall be carefully removed in such manner as not to endanger the construction, or other structures, utilities, or property. All voids left or caused by withdrawal of sheeting shall be immediately refilled with sand by ramming with tools especially adapted for that purpose, or otherwise directed by the Owner.
- g. The right of the Owner to order sheeting and bracing left in place shall not be construed as creating any obligation on his part to issue such orders, and his failure to exercise his right to do so shall not relieve the Contractor from liability for damages to persons or property occurring from or upon the work occasioned by negligence or otherwise, growing out of a failure on the part of the Contractor to leave in place sufficient sheeting and bracing to prevent any caving or moving of the ground.
- h. No wood sheeting is to be withdrawn if driven below mid-diameter of any pipe, and under no circumstances shall any wood sheeting be cut off at a level lower than one (1) foot above the top of any pipe.

2. Pumping and Drainage

- a. The Contractor shall at all times during construction provide and maintain proper equipment and facilities to remove all water entering excavations, and shall keep such excavations dry so as to obtain a satisfactory undisturbed subgrade foundation condition until the fills, structures or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural levels. The Contractor shall submit to the Engineer for review a

plan for dewatering systems prior to commencing work. The installed dewatering system shall be in conformity with the overall construction plan. The Contractor shall be required to monitor the performance of the dewatering systems during the progress of the work and require such modifications as may be required to assure that the systems are performing satisfactorily.

- b. Dewatering shall at all times be conducted in such a manner as to preserve the undisturbed bearing capacity of the subgrade soils at the bottom of the excavation and to preserve the integrity of adjacent structures. Well or sump installations shall be constructed with proper sand filters to prevent intermixing of finer grained soil from the surrounding ground.
- c. Water entering the excavation from surface runoff shall be collected in shallow ditches around the perimeter of the excavation, drained to sumps, and pumped from the excavation to maintain a bottom free from standing water.
- d. The Contractor shall take all additional precautions to prevent buoyant uplift of any structure during construction.
- e. The conveying of dewatered liquids in open ditches or trenches will not be allowed. Permission to use any storm sewers, or drains, for water disposal purposes shall be obtained from the authority having jurisdiction. Any requirements and costs for such use shall be the responsibility of the Contractor. The Contractor shall not cause flooding by overloading or blocking up the flow in the drainage facilities, and he shall leave the facilities unrestricted and as clean as originally found. Any damage to facilities shall be repaired or restored as directed by the Owner or the authority having jurisdiction, at no cost to the Owner.
- f. Flotation shall be prevented by the Contractor by maintaining a positive and continuous operation of the dewatering system. The Contractor shall be fully responsible and liable for all damages which may result from failure of this system.
- g. Removal of dewatering equipment shall be accomplished after the system is no longer required; the material and equipment constituting the system, shall be removed by the Contractor.
- h. The Contractor shall take all necessary precautions to preclude the accidental discharge of fuel, oil, etc. in order to prevent adverse effects on groundwater quality.

3.2 EXCAVATION

A. General

1. Excavation consists of removal, storage and disposal, if necessary, of material encountered when establishing required grade elevations and in accordance with the notes shown in the Drawings.
2. Unsuitable materials shall be removed under all proposed structures, pipes, and roads. Also, the unsuitable materials described above shall be removed outside of the structures, pipes, and roads by a margin equal to the depth of material, or 5 feet, whichever is greater. Replacement material shall be Common Fill placed and compacted as specified herein.
3. Authorized earth excavation includes removal and disposal of pavements and other obstructions visible on ground surface, underground structures and utilities indicated to be demolished and removed, and other materials encountered that are not classified as rock excavation or unauthorized excavation.
4. Unauthorized excavation consists of removal of material beyond the limits needed to establish required grade and subgrade elevations without specific direction of the Engineer and OAR. Unauthorized excavation, as well as remedial work shall be at the Contractor's expense. Backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise specified or directed by the Engineer.
5. When excavation has reached required subgrade elevations, make an inspection of conditions. If the material is unsuitable or has clay and/or organic material, and if authorized by Engineer to remove, carry excavation deeper and replace excavated material with Bedding Rock. Removal and replacement of unsuitable subgrade material, as directed by the Engineer, will be paid for as extra work by unit prices established in the Bid Form.
6. If the Contractor excavates below grade through error or for his own convenience or through failure to properly dewater the excavation or disturbs the subgrade before dewatering is sufficiently complete, he may be directed by the Engineer or OAR to excavate below grade as set forth in the preceding paragraph, in which case the work of excavating below grade and finishing and placing the refill shall be performed at his own expense.
7. Stockpile satisfactory excavated materials at a location approved by the Engineer and OAR until required for backfill or fill. Stockpiles shall be placed and graded for proper drainage. All soil materials shall be located away from the edge of excavations. Excess soil materials shall be disposed of by the Contractor, as directed by the OAR.

B. Trench Excavation

1. Excavation for all trenches required for the installation of pipes shall be made to the depths indicated on the Drawings and in such a manner and to such widths as will give suitable room for laying the pipe within the trenches, for bracing and supporting and for pumping and drainage facilities. The bottom of the excavations shall be firm and dry.
2. Excavation shall not exceed normal trench width. Normal trench width is defined as indicated on the Drawings. Any excavation which exceeds the normal trench width, shall require special backfill requirements as determined by the Engineer.
3. Rock shall be removed to provide at least eight inches clearance around the bottom and sides of the pipe being laid.
4. Where pipe is to be laid in Bedding Rock or encased in concrete, the trench may be excavated to or just below the designated subgrade provided that the material remaining in the bottom of the trench is no more than slightly disturbed.
5. Where the pipes are to be laid directly on the trench bottom, the lower part of the trenches shall not be excavated to grade by machinery. Manually trim and shape trench bottom to receive pipe at correct line and grade. Shape trench to provide a uniform, continuous support along the entire length of the barrel of each pipe section. Hand-shape firm unyielding bedding so that the bottom segment will be in continuous contact with the pipe barrel.

3.3 PLACEMENT OF MATERIALS

A. Fills

1. Material placed in fill areas shall be deposited within the lines and to the grades shown on the Drawings making due allowance for settlement of the material. Fill shall be placed only on properly prepared surfaces which have been inspected and approved. If sufficient Common Fill material is not available from excavation on site, the Contractor shall provide borrow as required at no additional cost to the Owner.
2. If necessary, fill shall be brought up in substantially level lifts not exceeding 8 inches in depth. The entire surface of the work shall be maintained free from ruts and in such condition that construction equipment can readily travel over any section. Fill shall not be placed against concrete structures until they have attained sufficient strength.
3. During the process of placing fill, all roots, debris and stones greater in size than specified herein shall be removed from the fill areas and the Contractor shall assign a sufficient number of employees to this work to insure satisfactory compliance with these requirements.

4. If the compacted surface of any layer of material is determined to be too smooth to bond properly with the succeeding layer, it shall be loosened by harrowing or by another approved method before the succeeding layer is placed.
5. All fill materials shall be placed and compacted "in-the-dry". The Contractor shall dewater excavated areas as required to perform the work in such a manner that will preserve the undisturbed state of the natural soils. The Contractor shall not claim excavated material as unsuitable due to moisture content. The Contractor shall sufficiently dewater excavated materials for use as backfill.
6. Prior to filling, the ground surface shall be prepared by removing vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials. Plow strip or break up sloped surfaces steeper than one vertical to four horizontal so that fill material will bond with the existing surface.
7. Before compaction, moisten or aerate each layer as necessary to provide the optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each classification.

B. Bedding and Backfilling for Pipes

1. Bedding for pipe shall be as shown on the Drawings. The Contractor shall take all precautions necessary to maintain the bedding in a compacted state and to prevent washing, erosion or loosening of this bed.
2. Backfilling over and around pipes shall begin as soon as practicable after the pipe has been laid, jointed and inspected and the trench filled with suitable material to the mid-diameter of the pipe. All backfilling shall be prosecuted expeditiously and as detailed on the Drawings.
3. After the pipe is laid to line and grade, place and carefully compact pipe bedding material for the full width of the trench to the springline of the pipe. Place the material around the pipe in 6-inch layers and thoroughly hand tamp with approved tamping equipment supplemented by "walking in" and slicing with a shovel to assure that all voids are filled. Place backfill in 6-inch layers and carefully compact the area above the pipe springline with pipe cover material to a point 12 inches above the top outside surface of the pipe barrel. Pipe bedding material may, at the Contractor's option, be substituted for pipe cover material. The backfilling shall be carried up evenly on both sides of the pipe. The remainder of the trench backfill shall then be filled and thoroughly compacted in uniform layers not exceeding 12 inches in depth.

- C. Backfill around structures shall be placed in uniform layers not exceeding 8 inches in depth. Backfill material shall be Common Fill meeting requirements set

forth in Paragraph 2.01. All backfill shall be placed and compacted "in-the-dry." Backfill operations around structures shall not be started until the concrete has attained sufficient strength to resist the loads imposed by the backfill material.

3.4 COMPACTION

A. General

1. The Contractor shall control soil compaction during construction to provide the densities specified. It shall be the Contractor's responsibility to notify the Engineer and OAR in writing that compaction tests can be performed. Written notice from the Contractor shall precede completion of compaction operations by at least two (2) working days.
2. Material which is too wet shall be spread over the fill area and permitted to dry, assisted by harrowing if necessary, until the moisture content is reduced to allowable limits. If added moisture is required, water shall be applied to provide a satisfactory moisture content. If too much water is added, the area shall be permitted to dry before compaction is continued. The Contractor shall supply all hose, piping, valves, sprinklers, pumps, sprinkler tanks, hauling equipment and other materials and equipment necessary to place water in the fill in the manner specified.
3. When a trench or excavation bottom has a density less than that specified herein for the particular area classification, the Contractor shall compact the material to the required depth and percentage of maximum density.

B. Percentage of Maximum Density Requirements

1. All backfill shall be compacted to not less than 95% of the maximum dry density as measured by AASHTO T-180 Method "D" Test (Modified Proctor) in open areas and to not less than 98% maximum dry density as measured by AASHTO T-180 Method "D" Test (Modified Proctor) under structures and asphalt or concrete pavement. All soil testing to be conducted by the Contractor.

3.5 FIELD QUALITY CONTROL

- A. Quality Control Testing during Construction: Allow testing service to inspect and approve subgrades and fill layers.
- B. If, in the opinion of the Engineer and/or OAR, based on testing service reports and inspection, subgrade or fills which have been placed are below specified density, provide additional compaction and testing at no additional expense.

3.6 FINAL GRADING

- A. After other earthwork work has been finished, and filling and backfilling operations are completed, all areas on the site of the work which are to be graded shall be brought to grade within a tolerance of +/- 0.1 feet at the indicated elevations, slopes, and contours where seeding or sodding is not required or, where sodding is required, within three (3) inches of finished grade. Use of graders or other power equipment will be permitted for final grading and dressing of slopes, provided the result is uniform and equivalent to hand work. All surfaces shall be graded to secure effective drainage. Unless otherwise shown, a slope of at least one percent shall be provided.

3.7 EXCESS EXCAVATED MATERIALS

- A. Insofar as needed, suitable excavated materials shall be used in fills and embankments shown on the Drawings. All excess excavated material shall be disposed of off-site by the Contractor.
- B. The Contractor shall segregate different types of excavated materials (i.e. sands, clayey sands) in the stockpile area. All unsuitable materials shall be disposed of by the Contractor offsite in a legal manner.
- C. The Contractor shall slope and compact the stockpile with a light roller to maintain stability.
- D. The Contractor shall maintain proper soil and erosion control measures.

END OF SECTION

SECTION 31 11 00 - CLEARING, GRUBBING, AND STRIPPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope of Work: This Section describes the work included in clearing, grubbing, stripping, and otherwise preparing the project site for construction operations.
- B. Related Work Specified Elsewhere:
 - 1. Earthwork: Section 31 00 00.
- C. Definitions:
 - 1. Clearing: Remove and dispose of shrubs, brush, limbs, and other vegetative growth. Remove all evidence of their presence from the surface including sticks and branches. Remove and dispose of trash piles and rubbish that currently is scattered over the construction site or collects there during construction. Protect trees, shrubs, vegetative growth, and fencing which are not designed for removal. Clearing operations shall be conducted so as to prevent damage to existing structures and installations, and to those under construction, so as to provide for safety of employees and others.
 - 2. Grubbing: Grubbing shall consist of the complete removal of all stumps, roots larger than 1-1/2 inches in diameter, matted roots, brush, timber, logs, and any other organic or metallic debris remaining after clearing not suitable for foundation purposes, resting on, under or protruding through the surface of the ground to a depth of 18 inches below the subgrade. All depressions excavated below the original ground surface for or by the removal of such objects, shall be refilled with suitable materials and compacted to a density conforming to the surrounding ground surface.
 - 3. Stripping: Remove and dispose of all organics and sod, topsoil, grass, and grass roots, and other objectionable material remaining after clearing and grubbing from the areas designated to be stripped. Grass, grass roots and organic material in areas to be excavated or filled shall be stripped to the depth as noted in the soils report. In areas so designated, topsoil shall be stockpiled. Strippings and unsuitable material, such as organic material, shall be disposed of by the Contractor unless directed otherwise by the OAR.

PART 2 - MATERIALS

2.1 GENERAL

- A. Trees and Shrubbery: Existing trees, shrubbery, and other vegetative material is not completely shown on the Drawings. Inspect the site as to the nature, location, size, and extent of vegetative material to be removed or preserved, as specified herein. Preserve, in place, trees that are specifically shown on the Drawings and designated to be preserved.
- B. Preservation of Trees, Shrubs, and Other Plant Material:
1. All plant materials (trees, shrubbery, and plants) beyond the limits of clearing and grubbing and/or labeled for preservation shall be saved and protected from damage resulting from the work. No filling, excavating, trenching, or stockpiling of materials will be permitted within the drip line of these plant materials. The drip line is defined as a circle drawn by extending a line vertically to the ground from the outermost branches of a plant or group of plants. To prevent soil compaction within the drip line area, no equipment will be permitted within this area.
 2. Trees identified on-site for preservation shall be fenced off by the Contractor at the dripline to protect the tree(s) during construction.
 3. When trees are close together, restrict entry to area within drip line by fencing. In areas where no fence is erected, the trunks of all trees 2 inches or greater in diameter shall be protected by encircling the trunk entirely with boards held securely by 12-gauge wire and staples. This protection shall extend from ground level to a height of 6 feet. Cut and remove tree branches where such cutting is necessary to affect construction operation. Remove branches other than those required to affect the work to provide a balanced appearance of any tree. Scars resulting from the removal of branches shall be treated with a tree sealant.

PART 3 - EXECUTION

3.1 GENERAL

- A. Clearing and Grubbing Limits: All excavation areas associated with new structures, slabs, and roadways shall be cleared and grubbed to the following depths:
1. Roadway and Paved Area: 2 feet below existing grade and replace with compacted backfill.

2. Proposed Structures: 2 feet below existing grade within a 5-foot margin of each structure and replaced with compacted backfill as specified herein.
 3. Building Site Areas not specifically noted above: 2 feet below existing grade and replaced with compacted backfill as specified herein.
 4. All other areas: 1 foot below completed surface.
- B. Disposal of Clearing and Grubbing Debris: Do not burn combustible materials. Remove all cleared and grubbed material from the work site and dispose of in accordance with all local laws, codes, and ordinances.
- C. Areas to be Stripped: All excavation and embankment areas associated with new structures, slabs, walks, and roadways shall be stripped. Stockpile areas shall be stripped.
- D. Disposal of Strippings: Remove all stripped material and dispose off-site, unless otherwise directed to stockpile material.

END OF SECTION

[THIS PAGE INTENTIONALLY LEFT BLANK]

SECTION 31 22 19 - FINISH GRADING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope of Work:

1. Finish grade sub-soil.
2. Cut out areas to receive stabilizing base course materials for limerock access road and parking areas.
3. Place, finish grade and compact topsoil.

B. Related Work Described Elsewhere:

1. Earthwork: Section 31 00 00.
2. Finish Grading: Section 31 22 19.
3. Solid Sodding: Section 32 92 23.

1.2 PROTECTION

- A. Prevent damage to existing fencing, trees, landscaping, natural features, bench marks and utility lines. Correct damage at no cost to the Owner.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Contractor to provide topsoil for use under sod areas.

2.2 MATERIALS AND EQUIPMENT

- A. Topsoil: Friable loam free from subsoil, roots, grass, excessive amounts of weeds, stones, and foreign matter; acidity ranges (pH) of 5.5 to 7.5; containing a minimum of 4 percent (4%) and a maximum of 25 percent (25%) organic matter. Use topsoil stockpiles on site if conforming to these requirements.

PART 3 - EXECUTION

3.1 PREPARATION

A. Sub-soil Preparation:

1. Rough grade sub-soil systematically to allow for a maximum amount of natural settlement and compaction. Eliminate uneven areas and low spots. Remove debris, roots, branches, stones, etc. Remove sub-soil which has been contaminated with petroleum products.
2. Cut out areas to sub-grade elevations, which are to receive stabilizing base for paving and sidewalks.
3. Bring sub-soil to required levels, profiles, and contours. Make changes in grade gradual. Blend slopes into level areas.
4. Slope grade away from building minimum 2 inches in 10 feet unless indicated otherwise on the Drawings.
5. Cultivate sub-grade to a depth of 3 inches, where topsoil is to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compact sub-soil.

3.2 INSTALLATION

A. Placing Topsoil:

1. Place topsoil in areas where seeding, sodding, and planting are to be performed. Place to the following minimum depths, up to finished grade elevations.
 - a. 6 inches for seeded areas.
 - b. 4-1/2 inches for sodded areas.
2. Use topsoil in relatively dry state. Place during dry weather.
3. Fine grade topsoil eliminating rough and low areas to ensure positive drainage. Maintain levels, profiles, and contours of sub-grade.
4. Remove stone, roots, grass, weeds, debris and other foreign material while spreading.
5. Manually spread soil around trees, plants, buildings, to prevent damage which may be caused by grading equipment.
6. Lightly compact placed topsoil.

B. Surplus Material:

1. Remove surplus sub-soil and topsoil from site.
2. Leave stockpile areas and entire job site clean and raked, ready to receive landscaping.

END OF SECTION

[THIS PAGE INTENTIONALLY LEFT BLANK]

SECTION 31 23 19 - DEWATERING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope of Work: The work to be performed under this Section shall include the design and installation of a temporary wellpoint system until completion of construction to dewater subsurface waters from structures as required.
- B. Related Work Described Elsewhere:
 - 1. Shop Drawings, Products and Samples: Section 01 33 23.
 - 2. Earthwork: Section 31 00 00.
- C. The Contractor shall obtain necessary permits from the Water Management District for dewatering.

1.2 QUALITY ASSURANCE

- A. Qualifications: The temporary dewatering system shall be designed by a firm who regularly engages in the design of dewatering systems and who is fully experienced, reputable and qualified in the design of such dewatering systems. The firm shall have a successful record of operation for a minimum of five (5) years prior to bid date.
- B. Standards: The dewatering of any excavation areas and the disposal of water during construction shall be in strict accordance with all local and State government rules and regulations.

1.3 SUBMITTALS

- A. Materials and Shop Drawings: Shop drawings required to establish compliance with the Specifications shall be submitted in accordance with the provisions of Section 01 33 23: Shop Drawings, Products and Samples shall include at minimum the following:
 - 1. Design notes and drawings.
 - 2. Descriptive literature of the temporary dewatering system.

3. Layout of all piping involved.
4. Bill of materials.
5. Water Management District permit, if required.

1.4 CRITERIA

- A. The wellpoint system shall be developed to the point that is capable of dewatering such that groundwater levels are maintained at least three (3) feet below the bottom of excavations. Each wellpoint system shall be capable of dewatering and maintaining groundwater levels at the respective structures. Observation wells shall be constructed for the purpose of testing each system.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The equipment specified herein shall be standard dewatering equipment of proven ability as designed and manufactured by firms having experience in the design and production of such equipment. The equipment furnished shall be designed, constructed and installed in accordance with the best practices and methods.
- B. The Contractor shall be required to monitor the performance of the dewatering system during the progress of the work and require such modifications as may be required to assure that the systems will perform satisfactorily. Dewatering systems shall be designed in such a manner as to preserve the undisturbed bearing capacity of the subgrade soils and to preserve the integrity of adjacent structures.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Dewatering: The Contractor shall install a temporary wellpoint dewatering system for the removal of subsurface water encountered during construction of the proposed structures.

3.2 PROTECTION AND SITE CLEAN-UP

- A. At all times during the progress of the Work the Contractor shall use all reasonable precautions to prevent either tampering with the wellpoints or the entrance of foreign material.

- B. After the wellpoint system is no longer needed, the Contractor shall remove all of his equipment, materials, and supplies from the site of the work, remove all surplus materials and debris, fill in all holes or excavations, and grade the site to elevations of the surface levels which existed before work started. The site shall be thoroughly cleaned and approved by the Engineer.

END OF SECTION

[THIS PAGE INTENTIONALLY LEFT BLANK]

SECTION 32 16 00 - CONCRETE CURBS AND GUTTERS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section includes materials and construction of curbs, valley gutters, curb and gutter, and Miami curb. All construction shall be in accordance with the latest standards in effect at the time of bidding that are required by the City of Orlando, Florida Department of Transportation (FDOT), and Greater Orlando Aviation Authority (GOAA), and shall adhere to the most stringent standard, as determined by the Engineer and OAR. If any information in these specifications differs from that of those agency standards listed above, the most stringent standard shall be adhered to, as determined by the Engineer and OAR.

- B. Related Work Described Elsewhere:
 - 1. Earthwork: Section 31 00 00.

- C. Standards
 - 1. Determine the density of soil in place by the sand cone method, ASTM D1556; by nuclear methods, ASTM D2922 or D3017.
 - 2. Determine laboratory moisture-density relations of soils by ASTM D1557 (Modified Proctor).
 - 3. Determine the relative density of cohesionless soils by ASTM D2049.
 - 4. Sample backfill material by ASTM D75.
 - 5. "Relative density" is the ratio, expressed as a percentage, of the in-place dry density to the laboratory maximum dry density as determined by ASTM D1557 (Modified Proctor).
 - 6. Testing: An independent testing laboratory will make density tests for determination of specific compaction and concrete cylinder tests. The Contractor is responsible for the costs of testing to determine conformance with these specifications.

1.2 SUBMITTALS

- A. All materials specified shall be certified by the producer or manufacturer that the furnished materials meet specified requirements of the specification.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Make all concrete curbs with Class 1 concrete, minimum 28-day compressive strength of 3000 psi, in accordance with the applicable sections of these specifications.
- B. Concrete shall comply with the requirements of these specifications.
- C. Reinforcement, Joint Materials, and Forms: Comply with applicable sections of these specifications.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Foundation: Excavate or backfill to the required depth. Stabilize the foundation material upon which the curb is to be set as shown on the construction plans with an even surface, true to line, grade and cross section, and soaking wet at the time that the concrete is placed.
- B. Forms: Place forms straight, free from warp or bends, and set to the line and grades shown on the drawings.
- C. Placing Concrete: Place concrete in the forms. Tamp and spade until mortar entirely covers its surface. Float the top of the concrete smooth and round the edges to the radius shown in the plans.
- D. Joints: Except for machine-placed items, at the option of the Contractor, contraction joints may be formed by the use of dummy joints (either formed or sawed) or by the use of sheet metal templates. If sheet metal templates are used, make them 1/4-inch thick and other dimensions same as cross section of form. Hold templates firmly during the placing of the concrete and leave in place until the concrete has set sufficiently to hold its shape, but remove while the forms are still in place.

For machine-placed items, unless otherwise approved, saw contraction joints approximately 3/16-inch wide and 1-1/2-inch deep in curb and gutter as soon as the concrete has hardened to the degree that excessive raveling will not occur and before uncontrolled shrinkage cracking begins. Space contraction joints at intervals of 10 feet, except where lesser interval is required for closure, but make no section less than 4 feet in length. Construct expansion joints at all inlets, at all radius points, in other locations indicated in the plans at intervals of 500 feet between other expansion joints or ends of a run. The joints shall be 1/2-inch in width.

- E. Finishing: Finish all exposed surfaces while the concrete is still green. In general, only a brush finish will be required. For any surface areas, however, which are too rough or have other surface defects which make additional finishing necessary, rub the curb to a smooth surface with a soft brick or wood block, with water used liberally.
- F. Curing: Continuously cure the concrete for a period of at least 72 hours. Commence curing after finishing has been completed and as soon as the concrete has hardened sufficiently to permit application of the curing material without marring the surface. Replace immediately any curing material removed or damaged during the 72-hour period. Curing will be done by the membrane curing compound method.

To cure by the membrane curing compound method, apply clear membrane curing compound or white pigmented curing compound by a hand sprayer in a single coat continuous film and uniform coverage of at least one gallon to each 200 square feet. Thoroughly agitate the curing compound in the drum prior to application and during application as necessary to prevent settlement of pigment. Re-coat immediately any cracks, chips or other defects appearing in the coating.

- G. Backfilling and Compacting: After the concrete has set sufficiently, fill the spaces in back of the curb to the required elevation with suitable material and compact to 90 percent relative density.
- H. Machine Laid Curb: Concrete curbs may be installed by machines without forming, provided that the finished product is straight, free from warp or bends, and does not deviate from the design line and grade or cross section.
- I. Testing: Sample and cure the concrete in accordance with ASTM C31, except take not less than five (5) 6-inch by 12-inch cylinders for each 50 cubic yards poured or each day's pour less than 50 cubic yards. A slump test may be taken in conformity with ASTM C143, and the cylinders shall be tested in accordance with ASTM C39.

The finished curbs, valley gutters, and curb and gutters, and Miami curbs shall be within 0.02 feet of the lines and grades shown on the plans. The finished concrete shall be smooth to within 1/4-inch in ten feet, without cracks (other than contraction joints) and without puddled or tapped water deeper than 1/4-inch

Remove and replace all work that does not meet above requirements.

PART 4 – METHOD OF MEASUREMENT

- 4.1 The quantity of curb and gutter shall be the actual number of linear feet of curb and gutter constructed. All work, labor, equipment, material, and incidentals described in this Specification shall be included in the appropriate pay item.

END OF SECTION

ITEM 32 31 13 CHAIN-LINK FENCE**DESCRIPTION**

32 31 13-1.1 This item shall consist of furnishing and erecting a chain-link fence in accordance with these specifications, the details shown on the plans, and in conformity with the lines and grades shown on the plans or established by the Engineer.

MATERIALS

32 31 13-2.1 Fabric. The fabric shall be woven with a 9-gauge galvanized steel wire in a 2-inch (50 mm) mesh and shall meet the requirements of **ASTM A392, Class 2**. Add alternative to include black vinyl-coating on the fabric. Vinyl-coated fabric shall be considered incidental to the component for which it is a part.

32 31 13-2.2 Barbed wire. Not Used.

32 31 13-2.3 Posts, rails, and braces. Line posts, rails, and braces shall conform to the requirements of ASTM F1043 or ASTM F1083 as follows:

Galvanized tubular steel pipe shall conform to the requirements of Group IA, (Schedule 40) coatings conforming to Type A, or Group IC (High Strength Pipe), External coating Type B, and internal coating Type B or D.

Roll Formed Steel Shapes (C-Sections) shall conform to the requirements of Group IIA, and be galvanized in accordance with the requirements of ASTM F1043, Type A.

Hot-Rolled Shapes (H Beams) shall meet the requirements of Group III, and be galvanized in accordance with the requirements of ASTM F1043, Type A.

Aluminum Pipe shall conform to the requirements of Group IB.

Aluminum Shapes shall conform to the requirements of Group IIB.

Vinyl or polyester coated steel shall conform to the requirements of ASTM F1043, Paragraph 7.3, Optional Supplemental Color Coating.

Composite posts shall conform to the strength requirements of ASTM F1043 or ASTM F1083. The strength loss of composite posts shall not exceed 10% when subjected to 3,600 hours of exposure to light and water in accordance with ASTM G152, ASTM G153, ASTM G154, and ASTM G155.

Posts, rails, and braces furnished for use in conjunction with aluminum alloy fabric shall be aluminum alloy or composite.

Posts, rails, and braces, with the exception of galvanized steel conforming to ASTM F1043 or ASTM F1083, Group 1A, Type A, or aluminum alloy, shall demonstrate the ability to withstand testing in salt spray in accordance with ASTM B117 as follows:

- External: 1,000 hours with a maximum of 5% red rust.
- Internal: 650 hours with a maximum of 5% red rust.

The dimensions of the posts, rails, and braces shall be in accordance with Tables I through VI of Federal Specification RR-F-191/3.

32 31 13-2.4 Gates. Gate frames shall consist of **galvanized steel pipe** and shall conform to the specifications for the same material under paragraph 32 31 13-2.3. The fabric shall be of the same type material as used in the fence.

32 31 13-2.5 Wire ties and tension wires. Wire ties for use in conjunction with a given type of fabric shall be of the same material and coating weight identified with the fabric type. Tension wire shall be 7-gauge marcelled steel wire with the same coating as the fabric type and shall conform to ASTM A824. ***Bottom tension wire shall be attached to the mesh fabric at twenty-four (24) inches on center. Maximum spacing with wire ties.***

All material shall conform to Federal Specification RR-F-191/4.

32 31 13-2.6 Miscellaneous fittings and hardware. Miscellaneous steel fittings and hardware for use with **zinc-coated** steel fabric shall be of commercial grade steel or better quality, wrought or cast as appropriate to the article, and sufficient in strength to provide a balanced design when used in conjunction with fabric posts, and wires of the quality specified herein. ***All steel fittings and hardware shall be protected with a zinc coating applied in conformance with ASTM A153.*** Barbed wire support arms shall withstand a load of 250 pounds (113 kg) applied vertically to the outermost end of the arm.

32 31 13-2.7 Concrete. Concrete shall be of a commercial grade with a minimum 28-day compressive strength of 4,000 psi.

32 31 13-2.8 Marking. Each roll of fabric shall carry a tag showing the kind of base metal (steel, aluminum, or aluminum alloy number), kind of coating, the gauge of the wire, the length of fencing in the roll, and the name of the manufacturer. Posts, wire, and other fittings shall be identified as to manufacturer, kind of base metal (steel, aluminum, or aluminum alloy number), and kind of coating.

32 31 13-2.9 Course Aggregate Bed. Not used.

CONSTRUCTION METHODS

32 31 13-3.1 Clearing fence line. All trees, brush, stumps, logs, and other debris which would interfere with the proper construction of the fence in the required location shall be removed a minimum width of 5 feet (1.5 m) on each side of the fence centerline before starting fencing operations. The cost of removing and disposing of the material shall not constitute a pay item and shall be considered incidental to fence construction.

32 31 13-3.2 Installing posts. All posts shall be set in concrete at the required dimension and depth and at the spacing shown on the plans.

The concrete shall be thoroughly compacted around the posts by tamping or vibrating and shall have a smooth finish slightly higher than the ground and sloped to drain away from the posts. All posts shall be set plumb and to the required grade and alignment. No materials shall be installed on the posts, nor shall the posts be disturbed in any manner within seven (7) days after the individual post footing is completed.

Should rock be encountered at a depth less than the planned footing depth, a hole 2 inches (50 mm) larger than the greatest dimension of the posts shall be drilled to a depth of 12 inches (300 mm). After the posts are set, the remainder of the drilled hole shall be filled with grout, composed of one part Portland cement and two parts mortar sand. Any remaining space above the rock shall be filled with concrete in the manner described above.

In lieu of drilling, the rock may be excavated to the required footing depth. No extra compensation shall be made for rock excavation.

32 31 13-3.3 Installing top rails. The top rail shall be continuous and shall pass through the post tops. The coupling used to join the top rail lengths shall allow for expansion.

32 31 13-3.4 Installing braces. Horizontal brace rails, with diagonal truss rods and turnbuckles, shall be installed at all terminal posts.

32 31 13-3.5 Installing fabric. The wire fabric shall be firmly attached to the posts and braced as shown on the plans. All wire shall be stretched taut and shall be installed to the required elevations. The fence shall generally follow the contour of the ground, with the bottom of the fence fabric no less than one inch (25 mm) or more than 4 inches (100 mm) from the ground surface. Grading shall be performed where necessary to provide a neat appearance.

At locations of small natural swales or drainage ditches and where it is not practical to have the fence conform to the general contour of the ground surface, longer posts may be used and multiple strands of barbed wire stretched to span the opening below the fence. The vertical clearance between strands of barbed wire shall be 6 inches (150 mm) or less.

32 31 13-3.6 Electrical grounds. Electrical grounds shall be constructed **at 500 feet (150 m) intervals. The ground shall be installed directly below the point of crossing.** The ground shall

be accomplished with a copper clad rod 8 feet (2.4 m) long and a minimum of 5/8 inches (16 mm) in diameter driven vertically until the top is 6 inches (150 mm) below the ground surface. A No. 6 solid copper conductor shall be clamped to the rod and to the fence in such a manner that each element of the fence is grounded. Installation of ground rods shall not constitute a pay item and shall be considered incidental to fence construction. The Contractor shall comply with FAA-STD-019, Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment, Paragraph 4.2.3.8, Lightning Protection for Fences and Gates, when fencing is adjacent to FAA facilities.

32 31 13-3.7 Cleaning up. The Contractor shall remove from the vicinity of the completed work all tools, buildings, equipment, etc., used during construction. All disturbed areas shall be seeded per T-901.

METHOD OF MEASUREMENT & BASIS OF PAYMENT

The project is Lump Sum (LS). The LS price shall be full compensation for furnishing all materials, and for all preparation, erection, and installation of these materials, and for all labor equipment, tools, and incidentals necessary to complete the item at locations shown in the plans.

MATERIAL REQUIREMENTS

ASTM A121	Standard Specification for Metallic-Coated Carbon Steel Barbed Wire (Not Used)
ASTM A123	Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A392	Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric
ASTM A491	Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric
ASTM A572	Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A653	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A824	Standard Specification for Metallic-Coated Steel Marcellled Tension Wire for Use With Chain Link Fence
ASTM A1011	Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High Strength Low Alloy with Improved Formability, and Ultra High Strength
ASTM B117	Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B221	Standard Specification for Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Profiles and Tubes
ASTM B429	Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
ASTM F668	Standard Specification for Polyvinyl Chloride(PVC), Polyolefin and other Organic Polymer Coated Steel Chain-Link Fence Fabric
ASTM F1043	Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework
ASTM F1083	Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
ASTM F1183	Standard Specification for Aluminum Alloy Chain Link Fence Fabric
ASTM F1345	Standard Specification for Zinc 5% Aluminum-Mischmetal Alloy Coated Steel Chain-Link Fence Fabric
ASTM G152	Standard Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
ASTM G153	Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
ASTM G154	Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials
ASTM G155	Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Nonmetallic Materials
FED SPEC RR-F-191/3	Fencing, Wire and Post, Metal (Chain-Link Fence Posts, Top Rails and Braces)
FED SPEC RR-F-191/4	Fencing, Wire and Post, Metal (Chain-Link Fence Accessories)
FAA-STD-019	Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment

ORLANDO INTERNATIONAL AIRPORT
SOUTH TERMINAL C (BP-S00193)
EMPLOYEE PARKING LOT

CHAIN-LINK FENCE

Section 32 31 13

END OF ITEM 32 31 13

32 31 13 - 6

HNTB Corporation

February 7, 2022

SECTION 32 92 23 - SOLID SODDING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope of Work

1. Furnish all labor, materials, equipment and incidentals required to prepare lawn bed and install sodding as specified.
2. All pervious areas in project site shall receive sodded grass lawns that are disturbed during construction.

B. Related Work Described Elsewhere

1. Shop Drawings, Products and Samples: Section 01 33 23.
2. Earthwork: Section 31 00 00.

1.2 QUALITY ASSURANCE (NOT APPLICABLE)

1.3 SUBMITTALS

- A. Provide technical data as required in Section 01 33 23 regarding all materials or installation procedures required under this Section.
- B. Submit representative topsoil samples for analysis by a private laboratory to determine nutrient deficiencies and outline a proper fertilization program.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Loam (topsoil) shall be fertile, natural soil, typical of the locality, free from large stones, roots, sticks, peat, weeds and sod and obtained from naturally well drained areas. It shall not be excessively acid or alkaline nor contain toxic material harmful to plant growth. Topsoil stockpiled under other Sections of this Division may be used, but the Contractor shall furnish additional loam at his own expense, if required.

2.2 SOIL CONDITIONERS

A. Fertilizer:

1. Fertilizer shall be a complete fertilizer, the elements of which are derived from organic sources. Fertilizer shall be a standard product complying with State and Federal fertilizer laws.
2. Fertilizer shall be 6% nitrogen, 6% phosphorus and 6% potash by weight. At least 50% of the total nitrogen shall contain no less than 3% water- insoluble nitrogen.
3. Fertilizer shall be delivered to the site, mixed as specified, in the original unopened standard size bags showing weight, analysis and name of manufacturer. Containers shall bear the manufacturer's guaranteed statement of analysis, or a manufacturer's certificate of compliance covering analysis shall be furnished to the Engineer. Store fertilizer in a weatherproof place and in such a manner that it will be kept dry and its effectiveness will not be impaired.

B. Superphosphate shall be composed of finely ground phosphate rock as commonly used for agricultural purposes containing not less than 20 available phosphoric acid.

C. Lime shall be ground limestone.

2.3 SOD

- A. Sod shall be Argentine Bahia of firm texture having a compacted growth and good root development as approved. Proposed sod type should match existing sod type.
- B. Sod shall be certified to meet Florida State Plant Board specifications, absolutely true to varietal type, and free from weeds or other objectionable vegetation, fungus, insects and disease of any kind.
- C. Before being cut and lifted the sod shall have been mowed 3 times with the final mowing not more than a week before cutting into uniform dimensions.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Areas to be sodded shall be cleared of all rough grass, weeds, and debris, and ground brought to an even grade as approved.
- B. The soil shall then be thoroughly tilled to a minimum 8 inch depth.
- C. Loam shall be placed to a minimum depth of 4 inches and shall be lightly compacted. No loam shall be spread in water.
- D. Lime shall be applied at a rate necessary to achieve a pH of 6 to 7.
- E. Apply superphosphate at a rate of 5 pounds per 1,000 square feet and apply fertilizer at a rate of 16 pounds per 1,000 square feet.
- F. The areas shall then be brought to proper grade, free of sticks, stones, or other foreign matter over 1-inch in diameter or dimension. The surface shall conform to finish grade, less the thickness of sod, free of water-retaining depressions, the soil friable and of uniformly firm texture.

3.2 INSTALLATION

- A. During delivery, prior to planting, and during the planting of the lawn areas, the sod panels shall at all times be protected from excessive drying and unnecessary exposure of the roots to the sun. All sod shall be stacked during construction and protected so as not to be damaged by sweating or excessive heat and moisture.
- B. After completion of soil conditioning as specified above, sod panels shall be laid tightly together so as to make a solid sodded lawn area. On mounds and other slopes, the long dimension of the sod shall be laid perpendicular to the slope and with the joints offset relative to upper and lower panels. Immediately following sod laying the lawn areas shall be rolled with a lawn roller customarily used for such purposes, and then thoroughly watered.
- C. Bring the sod edge in a neat, clean manner to the edge of all paving and shrub areas. Top dressing with approved, clean weed free sand may be required at no additional cost to the Owner if deemed necessary by the Engineer.

3.3 MAINTENANCE

- A. The Contractor shall produce a dense, well established lawn. The Contractor shall be responsible for the repair and resodding of all eroded or bare spots until project acceptance and during the warranty period. Repair sodding shall be accomplished as in the original work except that fertilizing may be omitted. Sufficient watering shall be done by the Contractor to maintain adequate moisture for optimum development of the lawn areas. Sodded areas shall receive

no less than 1.5 inches of water per week. The Contractor shall also mow lawn areas once per week until final completion of the Project.

3.4 REPAIRS TO LAWN AREAS DISTURBED BY CONTRACTOR'S OPERATIONS

- A. Lawn areas planted under this Contract and any lawn areas damaged by Contractor's operations shall be repaired at once by proper sod bed preparation, fertilizing and resodding, in accordance with these Specifications.

END OF SECTION

SECTION 33 01 12 - LEAKAGE TESTING OF WATER RETAINING STRUCTURES

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Water tightness testing of reinforced concrete water retaining structures. All construction shall be in accordance with the latest standards in effect at the time of bidding that are required by the City of Orlando, Florida Department of Environmental Protection (FDEP), Florida Department of Transportation (FDOT), Greater Orlando Aviation Authority (GOAA), and the Federal Aviation Administration (FAA), and shall adhere to the most stringent standard, as determined by the Engineer and OAR. If any information in these specifications differs from that of those agency standards listed above, the most stringent standard shall be adhered to, as determined by the Engineer and OAR.

1.2 REFERENCE STANDARDS

- A. American Concrete Institute (ACI)
 - 1. ACI 350.1-01 – Tightness Testing of Environmental Engineering Concrete Structures.

PART 2 PRODUCTS

2.1 GENERAL

- A. Provide potable water, piping, and equipment required to test concrete structures for leakage.

PART 3 EXECUTION

3.1 GENERAL

- A. Hydrostatically test reinforced concrete structures which will contain water to requirements specified below, and are free of detectable leaks.
- B. Do not start leak testing or cleaning of surfaces until concrete is cured and joint sealants have set and cured a minimum of 14 days.
- C. Conduct testing before backfill is placed against walls.
- D. Prior to testing, clean exposed surfaces by thorough hosing, and remove surface laitance and loose matter from walls and slabs. Remove wash water and debris by means other than washing through plant piping.

3.2 TEST PROCEDURE

- A. Fill structure to be tested to the normal operating liquid level. Filling rate shall not exceed 4 feet of water per hour, and shall be at continuous uniform rate with continuous monitoring.
- B. The exterior surface of the tank shall be monitored for flowing leaks. Repair any flowing leaks which occur before continuing filling.
- C. The water shall be kept at the test level for at least three days prior to the actual test.
- D. Measure the vertical distance to the water surface from a fixed point on the tank above the water surface. Record measurements at 24-hour intervals.
- E. A drop of the water surface exceeding 1/20 of 1% of the normal volume of contained liquid will be considered failing.
- F. The structure will have also be considered to have failed the test if flowing or seeping water is observed, or if moisture can be transferred to a dry hand from the exterior surface.
- G. Independently measure change in water volume due to evaporation and precipitation using a 24 inch deep white, watertight container not less than 10 square feet of surface area. Position the container to experience environmental conditions similar to the structure being tested. The volume change of the structure shall be corrected based on the water volume change in the sample container.
- H. Failing tanks which exhibit no visible signs of leaking or seepage may be permitted to be immediately retested.
- I. Failing tanks will be drained, repaired, and retested until the tank has met the test requirements.

END OF SECTION

SECTION 33 01 30
LEAKAGE & INFILTRATION TESTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This section describes the requirements and procedures for leakage and infiltration testing of gravity sewer systems. The Contractor is required to meet the current standards and requirements of the City of Orlando, FDEP, and Orlando Utilities Commission (OUC). If any part of this section conflicts with the requirements of the authority having jurisdiction, the most stringent standard shall apply, as determined by the Engineer and OAR.

1.3 REFERENCE STANDARDS

- A. The publications listed below form part of this specification to the extent referenced and are referred to in the text by the basic designation only. Reference shall be made to the latest edition of said standards unless otherwise called for:
 - 1. UNI-Bell PVC Pipe Association "Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe" - UNI-B-6 (latest edition)
 - 2. City of Orlando Engineering Standards Manual (latest edition).

1.4 REQUIREMENTS PRIOR TO TESTING

- A. Trenching for all dry utilities such as electrical, telephone and cable television shall be completed prior to performing any tests on the sewer pipe.

1.5 TESTING

- A. Leakage Test: Each section of sewer pipe between two successive manholes shall be tested for leakage. The sewer laterals to the property line shall be included in the test.
- B. Infiltration Test: In addition to the leakage test, an infiltration test shall be made where groundwater is encountered, or evidence exists that groundwater has encroached to the elevation of the sewer.
- C. Closed Circuit Television: A closed circuit television inspection shall be required to be performed on the sewer installation.
- D. All tests shall be made in the presence of the City of Orlando Inspector and the Engineer of Record.

- E. Testing may be repeated, as directed by the City of Orlando Inspector and/or the Engineer of Record, if the subsequent construction operations of the Contractor or others may have damaged or affected the structural integrity of the sewer pipe and/or laterals.
- F. The official test will not be made until after all other utilities have been installed and trench compaction verified.
- G. All tests must be completed before the street or trench is paved, unless otherwise allowed by the City of Orlando Inspector and the Engineer of Record.
- H. Vacuum testing of manholes shall be performed in accordance with Section 333900

PART 2 – PRODUCTS

2.1 GENERAL

- A. The Contractor shall furnish all equipment and materials required for testing

PART 3 - EXECUTION

3.1 AIR TEST FOR PVC GRAVITY SEWERS

- A. PVC pipe shall be air pressure tested in accordance with the test procedures outlined in the UNI-Bell PVC Pipe Association "Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe" - UNI-B-6. The test shall be made only after the line has been properly installed including any necessary test fittings, and backfilled.
- B. Test plugs shall be carefully placed at each lateral and end of the section of the line to be tested. When all necessary test equipment is in place, a compressed air supply shall be attached within the line and increased to four pounds per square inch (4 psi) greater than the average back pressure of any groundwater above the pipe. After the air supply is securely turned off or disconnected, there shall be a two minute waiting period to allow stabilization of air within the sewer line before the actual test period begins. Air may be added only to maintain a pressure of 4.0 psig. When the internal pressure decreases to 3.5 psig, timing shall start and the seconds counted until the pressure has decreased to 2.5 psig.
- C. Minimum permissible pressure holding times for sewer main, with or without laterals, are listed in the Tables, as published in the latest UNI-Bell PVC Pipe Association "Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe" - UNI-B-6 The maximum length of a line that may be tested at one time shall be four hundred (400) feet, or the length between any two adjacent manholes, or where otherwise directed by the City of Orlando Inspector and/or the Engineer of Record. After completion of the test, the air pressure shall be released slowly through the valve, which is incorporated in the test equipment. Air test plugs shall not be removed until the air pressure is no longer measurable.
- D. All necessary test equipment shall be furnished by the Contractor and the Contractor shall conduct all testing at no cost to the Owner.

3.2 INFILTRATION TEST

- A. Prior to testing for infiltration, the ends of the sewer pipe section to be tested shall be cleaned using a Wayne Ball, all pipe shall be capped or plugged to prevent the entrance of water, and pumping of groundwater shall be discontinued for at least three (3) days.
- B. Any infiltration discovered before completion and acceptance of the sewer shall be corrected. The sewer shall be examined and the source of infiltration eliminated. Following repairs or replacement as necessary, including backfill and compaction, the subject line shall be retested to assure no infiltration.

3.3 CLOSED-CIRCUIT TELEVISION INSPECTION

- A. In addition to the leakage and infiltration tests, closed-circuit television inspections will be conducted by the Contractor as described in the City of Orlando Engineering Standards Manual, Section 9.03.05. The inspection shall be conducted after all utilities have been installed and the backfill compaction certified, but prior to final paving.
- B. Note: The City of Orlando Water Reclamation Division crews will conduct internal inspections only if systems are dedicated to the City. If the system is private, the contractor shall have the system internally inspected at their own cost. Water Reclamation Division must review all video recordings for approval of construction acceptability. CCTV inspection shall be performed and approved prior to asphalt construction. CCTV inspection shall be performed when roadway base course is stabilized, pipes cleaned of dirt and debris, and rings and covers set but asphalt paving course shall not be constructed.
- C. To insure the proper documentation and the integrity of newly installed sanitary sewer, all main pipelines, laterals and manholes shall be cleaned and all debris removed using high-velocity jet equipment (Hydro cleaning). All high-velocity sewer cleaning equipment shall be constructed for ease and safety of operation. The equipment shall have a selection of two or more high-velocity nozzles. The nozzles shall be capable of producing a scouring action from 15 to 45 degrees in all size lines designated to be cleaned. Equipment shall also include a high-velocity gun for washing and scouring manhole walls and floor. The gun shall be capable of producing flows from a fine spray to a solid stream. The equipment shall carry its own water tank, auxiliary engines, pumps and hydraulically driven hose reel.
- D. After cleaning, the line section shall be visually inspected by means of closed circuit television. The inspection will be performed one line section at a time. Prior to inspection, water will be introduced continuously into the upstream manhole until it appears in the downstream manhole. At the time, the water source will be terminated and the closed-circuit television inspection will commence.
- E. The television camera used for the inspection shall be one specifically designed and constructed for such inspection. A pan and tilt camera shall be used in pipes with a diameter of eight inches (8") and larger. Pipes with a diameter less than eight inches (8") shall be able to be inspected with a rear view camera. 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 one hundred percent (100%) humidity conditions. The camera shall also be equipped with depth gauge with one-quarter inch (1/4") increments and shall be two inches (2") in height. The camera, television, monitor and other components of the video system shall be capable of producing a high quality DVD format. The video image shall be clear, focused and relatively free from roll, static or other image distorting qualities which would prevent the reviewer from evaluating the condition of the sewer system.

- F. The camera shall be moved through the line in either direction at a moderate rate, stopping when necessary to permit proper documentation of the sewer's condition, panning and tilting as necessary with a speed slower than thirty feet (30') per minute. When a lateral is located, panning to look up the lateral for a minimum of ten (10) seconds for proper documentation of the connection and lateral will be required. In addition, all laterals shall be internally inspected, with a closed-circuit television camera designed for the smaller diameter pipe, from the clean-out assembly located at the property line to the sewer main. Manual winches, power winches, TV cable and powered rewinds or other devices that do not obstruct the camera's view or interfere with the proper documentation of the condition of the sewer, shall be used to move the camera through the sewer line.
- G. When manually operated winches are used to pull the television camera through the line, a suitable means of communication shall be set up between the two Engineering Standards Manual 148 5th Edition manholes of the section being inspected to insure good communications between members of the crew.
- H. The importance of accurate distance and manhole designation measurements is emphasized. Measurements for location of defects shall be above ground by means of a meter device, marking on the cable, or the like, which would require interpolation of depth of manhole, will not be allowed. Accuracy of the distance meter shall be checked by use of a walking meter, roll-a-tape or other suitable device and the accuracy shall be satisfactory to the City of Orlando's representative. Manhole identity will correspond to the set of plans which have been approved by the City of Orlando prior to construction.
- I. Documentation of the television shall be as follows:
 - a. Television Inspection Logs - Printed location records shall be kept by the contractor and will clearly show the location in relation to an adjacent manhole of each infiltration point observed during inspection. In addition, other points of significance such as location of building sewers, unusual conditions, roots, storm sewer connections, broken pipe, presence of scale and corrosion, gapped joints, rolled gaskets, deflections and other discernible features shall be recorded and documented in written logs. A copy of such records shall be supplied to the City of Orlando.
 - b. Video Recordings - The purpose of the video recording shall be to supply a clear visual and audio record of problem areas in the lines televised. Video playback shall be at the same speed that it was recorded. Video recording speed shall be standard DVD format. Prior to submission to the City, the TV inspection company will review the video to ensure that they meet the quality criteria set forth in the previous sections of this specification. A copy of such video, along with the television logs, will be supplied to the City within three (3) business days of completion of the job. In the event the video or television logs are deemed of poor

quality or substandard by the City of Orlando, the videos and/or logs shall be returned and a reinspection will be provided by the contractor, at no additional cost to the City.

- J. All defects and evidence of reverse slope by ponding of water or dips in pipe alignment revealed by the closed-circuit television inspection shall be repaired to the satisfaction of the City of Orlando Inspector and the Engineer of Record at the Contractors expense.

3.4 VACUUM TESTING OF MANHOLES

- A. Vacuum testing of manholes shall be performed in accordance with Section 33 39 00.

3.5 FINAL ACCEPTANCE

- A. The requirements of this section shall be considered acceptable when each sewer section's air leakage rate is less than the maximum allowed, the television inspection is satisfactory, and the water infiltration rate is zero.

END OF SECTION 33 01 30

INTENTIONALLY LEFT BLANK

SECTION 33 01 30.42 - CLEANING SANITARY SEWER SYSTEMS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The Work covered in this section consists of cleaning sewer lines and manholes prior to the internal television inspection(s) for new or existing wastewater systems.
- B. Gravity Main and Sewer Lateral Cleaning: The intent of gravity main cleaning is to remove debris that may be causing a reduction in flow capacity, potential sewer backups, or that limits the ability to evaluate the structural condition of the pipe segment. On all sewers, the Contractor shall perform sewer-cleaning work to an acceptable level as necessary to perform a thorough television inspection of the sewer. An acceptable level is defined as the removal of all debris throughout the pipe segment cleaned. If the pipe condition is such that cleaning may cause a potential collapse, then the pipe shall be televised without attempting to clean it pending approval by the Owner.
- C. Water for Cleaning: The Contractor will be responsible for obtaining a transient water meter and paying for water used during course of cleaning.
- D. Recovering of Equipment: The Contractor will be responsible for recovering any equipment that becomes lodged or lost in the pipeline. The Contractor is responsible for the cost, which will include cost associated with required evacuation, restoration of roads and easements, and repairs to pipes and manholes as needed to restore the pipeline and appurtenances back to their original conditions. Video documentation of pre-removal conditions will apply prior to any excavation.

1.2 CLEANING EQUIPMENT

- A. Hydraulically Propelled Equipment: The equipment used shall be of a movable dam type and be constructed in such a way that a portion of the dam may be collapsed at any time during the cleaning operation to protect against flooding of the sewer. The movable dam shall be equal in diameter to the pipe being cleaned and shall provide a flexible scraper around the outer periphery for grease removal. Special precautions to prevent flooding of the sewers and public or private property shall be taken at all times.
- B. High-Velocity Jet (Hydro-Cleaning) Equipment: All high-velocity sanitary sewer cleaning equipment shall be constructed for ease and safety of operation. The

equipment shall have a selection of 2 or more high-velocity nozzles. The nozzles shall be capable of producing a scouring action from 15° to 45° (degrees) in all size mains. Equipment shall also include a high-velocity gun for washing and scouring manhole walls and floor. The gun shall be capable of producing flows from a fine spray to a solid stream. The equipment shall carry its own water tanks, auxiliary engines, pumps, and hydraulically driven hose reel.

- C. Mechanically Powered Equipment: Bucket machines shall be in pairs with sufficient power to perform the Work in an efficient manner. Machines shall be belt operated or have an overload device. Machines with direct drive that could cause damage to the pipe will not be used. A power rodding machine shall be either a sectional or continuous rod type capable of holding a minimum of 750- feet of rod. The rod shall be heat-treated steel. To ensure safe operation, the machine shall be fully enclosed and have an automatic safety clutch or relief valve.
- D. Vacuum machines may be used for removal of materials from manholes when other cleaning equipment is used to dislodge and transport material to the access point.
- E. Combination Cleaner: For cleaning small and large diameter sewer, the Contractor may use a combination hydraulic high volume water and solids separation system. Water volume of up to 250-gpm at or above 2,000-psi will move solids to the downstream manhole in high flow conditions. The separation system will dewater solids to 95 % (passing a paint filter test) and transfer them to a dump truck, if needed, for transport to a water reclamation facility, approved landfill, or other location specified by the Owner or designee. Wash water will be filtered to a point where it can be used in the pump for continuous cleaning. No bypassing of sewer flows will be necessary. The unit shall be capable of 24-hour operation and the unit shall not leave the manhole until a section is fully cleaned.

1.3 SHOP DRAWINGS AND SUBMITTALS

- A. Submittals shall be submitted to the Owner for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01 33 23- Shop Drawings, Products, and Samples.
- B. A daily log shall be maintained to record the location of the manholes and sewer lines, lengths of the lines cleaned, method of cleaning, line sizes, identify type of cleaning (light, medium, or heavy), and type of debris moved. Observations are to be recorded on a cleaning report form.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

- A. The equipment shall remove dirt, grease, rocks, sand, other materials, and obstructions from the sewer mains, laterals, and manholes.
- B. A high-velocity sewer cleaner will be used for the majority of the cleaning work. Other equipment, such as bucket machines, rod machines, hydraulic root cutters, vacuum trucks and balling equipment shall be available.

3.2 CLEANING PRECAUTIONS

- A. All necessary precautions shall be taken to protect the sewer from damage during all cleaning and preparation operations. Precautions shall also be taken to ensure that no damage is caused to public or private property adjacent to or served by the sewer or its branches. The Contractor shall pay for and restore, at no additional costs to the Owner, any damage caused to public or private property because of such cleaning and preparation operations.
- B. Satisfactory precautions shall be taken in the use of cleaning equipment. When hydraulically propelled cleaning tools (which depend upon water pressure to provide their cleaning force) or tools which retard the flow in the sewer line are used, precautions shall be taken to ensure that the water pressure created does not damage or cause flooding of public or private property being served by the sewer. When possible, the flow of sewage in the sewer shall be utilized to provide the necessary pressure for hydraulic cleaning devices. When additional water from fire hydrants is necessary to avoid delay in normal work procedures, the water shall be conserved and not used unnecessarily. No fire hydrant shall be obstructed in case of a fire in the area served by the hydrant. All requirements shall be met when accessing a fire hydrant including but not limited to meters, backflow preventers, and properly trained personnel. It shall be the Contractor's responsibility to meet all state and local requirements.

3.3 CLEANING

- A. If cleaning of an entire sewer section cannot be successfully performed from one manhole, the equipment shall be set up on the other manhole and cleaning attempted again. If results of the cleaning are favorable, the Contractor will proceed with the TV inspection. All sludge, dirt, sand, rocks, and other solid or semisolid materials resulting from the cleaning operation shall be removed from the downstream manhole of the section being cleaned. The Contractor shall not be responsible for removing mortar or other material that is securely attached to the pipe walls or joints.
- B. Materials shall be disposed of from the site at least once at the end of each workday. The Contractor will be responsible for the disposal of materials removed from the sewer system. All sewer-cleaning efforts shall require documentation of all quantities and types of materials removed during cleaning.
- C. The designated sewer manhole sections shall be cleaned using hydraulically

propelled, high-velocity jet, or mechanically powered equipment approved by the Owner. Cleaning shall consist of normal hydraulic jet cleaning to facilitate the internal CCTV inspection.

1. Types of cleaning of sanitary sewers:
 - a. Light cleaning of sewers consists of a maximum of 1 pass of the jet nozzle. Light cleaning of laterals will consist of flushing water into a cleanout.
 - b. Medium cleaning of sewers consists of 2 to 4 passes of the jet nozzle. Medium cleaning of laterals will consist of 1 to 4 passes with a jet nozzle.
 - c. Heavy cleaning consists of 5 or more passes of the jet nozzle such as removing heavy grease, debris, and roots.
 - d. Descaling of Ductile Iron pipe: Multiple passes with mechanical equipment to remove scale build up to restore pipe to original inside diameter.
2. Selection of the equipment used shall be based on the conditions of lines at the time the Work commences. The equipment and methods selected shall be satisfactory to the Owner. The equipment shall be capable of removing dirt, grease, rocks, sand, debris, other materials, and obstructions from the sewer lines, laterals, and manholes.
3. If cleaning of an entire section cannot be successfully performed from one manhole, the equipment shall be set up on the other manhole and cleaning again attempted. The intent of preparatory cleaning is to provide sufficient cleaning to ensure camera passage and the internal conditions of the pipeline can be fully assessed.
4. If the Owner establishes that a particular section of the pipeline cannot be adequately cleaned due to broken, collapsed, or void areas, then the inspection will be attempted up to the obstruction.

3.4 ROOT REMOVAL

- A. Roots shall be removed in the designated sections and manholes where root intrusion is a problem and where authorized by the Owner. Special attention should be used during the cleaning operation to remove roots from the joints. Any roots that could prevent the proper application of chemical sealants or could prevent the proper seating and application of cured-in-place liners shall be removed. Procedures may include the use of mechanical equipment such as, rodding machines, bucket machines, winches using root cutters, porcupines, and equipment such as high-velocity jet cleaners. Chemical root treatment shall be used before or following the root removal operation, depending on the manufacturer's recommendation. The Contractor shall capture and remove all roots from the line.

3.5 CHEMICAL ROOT TREATMENT

- A. To aid in the removal of roots, manhole sections that have root intrusion shall be treated with an acceptable herbicide. The application of the herbicide to the roots shall be done in accordance with the manufacturer's recommendations and specifications in such a manner to preclude damage to surrounding vegetation. Any damaged vegetation, so designated by the Owner, shall be replaced by the Contractor at no additional cost to the Owner. All safety

precautions as recommended by the manufacturer shall be adhered to for handling and application of the herbicide.

3.6 MATERIAL REMOVAL AND DISPOSAL

- A. All sludge, dirt, sand, rocks, grease, roots, and other solid or semisolid material resulting from the cleaning operation shall be removed at the downstream manhole of the section being cleaned. Contractor shall provide appropriate screening to stop passing of materials into downstream sewers. All solid or semisolid materials dislodged during cleaning operations shall be removed from the sewer by Contractor at the downstream manhole of the sewer section being cleaned. The passing of dislodged materials downstream of the sewer segment being cleaned shall not be permitted. In such an event, as observed or detected by the Owner or any third party, Contractor shall be responsible for cleaning the affected downstream sewers in their entirety, at no additional cost to the Owner.
- B. These materials shall become the property of the Contractor, shall be removed from the site at the end of each workday, and shall be disposed of by the Contractor. Copies of records of all disposals shall be furnished to the Owner, indicating disposal site, date, amount, and a brief description of material disposed. Disposal manifests from the licensed disposal facility shall be submitted with invoices.
- C. The Contractor shall keep his haul route and work area(s) neat, clean, and reasonably free of odor, and shall bear all responsibility for the cleanup of any spill.

3.7 ACCEPTANCE OF CLEANING OPERATION

- A. Acceptance of sanitary sewer cleaning shall be made upon the successful completion of the television inspection and shall be to the satisfaction of the Owner. If television inspection shows the cleaning to be unsatisfactory, the Contractor shall be required to re-clean and re-inspect the sewer line at no additional cost until the cleaning is shown to be satisfactory.
- B. In addition, on all sanitary sewers which have sags or dips, to an extent that the television camera lens becomes submerged during the television inspection, the Contractor shall use a high pressure cleaner to draw the water out of the pipe, or other means, to allow the full circumferential view of the pipe and identification of pipe defects, cracks, holes, and location of service connections.

END OF SECTION

SECTION 33 05 05 – PROCESS AND UTILITY PIPING, FITTINGS, VALVES, AND
ACCESSORIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope of Work: The Work included in this Section consists of furnishing all labor, equipment, and materials and performing all operations necessary for the construction or installation of all process and utility piping, valves, and appurtenances complete and ready for operation as shown on the Drawings and specified herein.
- B. All construction shall be in accordance with the latest standards in effect at the time of bidding that are required by the City of Orlando, Orlando Utilities Commission (OUC), Florida Department of Environmental Protection (FDEP), Florida Department of Transportation (FDOT), Greater Orlando Aviation Authority (GOAA), and the Federal Aviation Administration (FAA), and shall adhere to the most stringent standard, as determined by the Engineer and OAR. If any information in these specifications differs from that of those agency standards listed above, the most stringent standard shall be adhered to, as determined by the Engineer and OAR.
- C. Related Work Described Elsewhere
 - 1. Shop Drawings, Products and Samples: Section 01 33 23.
 - 2. Earthwork: Section 31 00 00.
 - 3. Concrete: Division 3.
 - 4. Painting: Division 9.
 - 5. Equipment: Division 11.
 - 6. Pressure Testing of Piping: Section 33 05 05.

1.2 QUALITY ASSURANCE

- A. Construction Requirements
 - 1. All the buried lines on-site shall be installed with at least 36 inches of cover, unless otherwise shown or indicated on the Drawings.
- B. Pipe Inspection: The Contractor shall obtain from the pipe manufacturers a certificate of inspection stating that the pipe and fittings supplied for this Contract have been inspected at the plant and that they meet the requirements of these Specifications. All pipe and fittings shall be subject to visual inspection at

time of delivery and also just before they are lowered into the trench to be laid. Joints or fittings that do not conform to these Specifications will be rejected and must be removed immediately by the Contractor. The entire product of any plant may be rejected when, in the opinion of the Engineer, the methods of manufacture fail to secure uniform results, or where the materials used are such as to produce inferior pipe or fittings.

1.3 SUBMITTALS

A. Shop Drawings

1. In general, the following Shop Drawings shall be submitted to the Engineer and OAR for approval prior to construction:
 - a. Valve and meter boxes.
 - b. All valves, including gate, plug, ball, check, and air release valves.
 - c. Couplings.
 - d. Pressure gauges.
 - e. Flexible expansion joints, tie rods, and flanged coupling adapters.
 - f. Joint lubricant.
 - g. Temporary plug and anchorage system for hydrostatic pressure test.
 - h. Detailed piping layout drawings and pipe laying schedule (see below).
2. Tabulated layout schedule for each pipe system including:
 - a. Pipe invert station and elevation at each change of grade and alignment.
 - b. The limits of each reach of pipe thickness class and of restrained joints.
 - c. The limits of each reach of concrete encasement.
 - d. Locations of valves and other mechanical equipment.
 - e. Methods and locations of supports.
 - f. Details of special elbows and fittings.

3. A separate shop drawing submittal will be required for each major item listed above and for each different type of an item within a major item. For example, separate submittals will be required for plug, solenoid, check, and automatic air release valves. All submittals shall be in accordance with the General and Special Conditions and Section 01 33 23: Shop Drawings, Products and Samples.

B. Acceptance of Material

1. The Contractor shall furnish an affidavit of compliance certified by the pipe manufacturer that the pipe, fittings, and specials furnished under this Contract comply with all applicable provisions of current AWWA and ASTM Standards and these Specifications. No pipe or fittings will be accepted for use in the Work on this project until the affidavit has been submitted and approved by the Engineer.
2. The Owner reserves the right to sample and test any pipe or fitting after delivery and to reject all pipe and fittings represented by any sample which fails to comply with the specified requirements.

C. Operation and Maintenance Manuals: Submit operation and maintenance manuals for applicable components requiring periodic maintenance and/or explanation of operation. Information shall include:

1. Detailed assembly drawings, clear and concise instructions for operating, adjusting, overhauling, troubleshooting and, other maintenance. Include shop drawings previously submitted and approved with all corrections made.
2. A complete lubrication schedule including lubricant types, grades, and recommended frequency of lubrication.
3. A list of parts for all products with catalog numbers and all data necessary for ordering replacement parts. Such instructions and parts lists shall be prepared for the specific product furnished and shall not refer to other types or models.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Pipe, fittings, valves, and accessories shall be handled in a manner that will ensure a sound undamaged condition during shipping, delivering and installing.
- B. Particular care shall be taken not to injure the pipe coating and linings.
- C. Insides of valves and piping shall be kept free of dirt and debris.

1.5 JOB CONDITIONS

- A. Water in Excavation: Water shall not be allowed in the trenches while underground pipes are being laid and/or tested. The Contractor shall not open more trench than the available pumping facilities are able to dewater to the satisfaction of the Engineer. The Contractor shall assume responsibility for disposing of all water so as not to injure or interfere with the normal drainage of the territory in which he is working. In no case shall the pipelines being installed be used as drains for such water, and the ends of the pipe shall be kept properly and adequately plugged during construction by the use of approved plugs or caps and not by improvised equipment. All necessary precautions shall be taken to prevent the entrance of mud, sand, or other obstructing matter into the pipelines. If on completion of the work any such materials have entered the pipelines, it must be cleaned as directed by the Engineer so that the entire system will be left clean and unobstructed.

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE AND FITTINGS

- A. Ductile Iron Pipe: Ductile iron pipe shall conform to the requirements of ANSI, A21.51 and AWWA C151, latest revision. The minimum pressure class for underground pipes shall be Class 350. Pipe shall be furnished in laying lengths of 20 feet or less, unless specifically shown otherwise on the Drawings. Flanged pipe shall have a minimum thickness class of Class 53. All pipe and fittings shall be new and unused, no refurbished piping or fittings will be accepted.
- B. Coating and Lining
1. Corrosion Resistant Interior Lining: In accordance with the pipe material schedule, ductile iron pipe, fittings, and specials shall be lined with Protecto 401 Ceramic Epoxy or Permax Pipe Glaze, PC3-9043, Type II Glass-Flake Filled Epoxy Pipe Coating with a minimum dry film thickness of 40 mils applied by the pipe manufacturer. Storage, surface preparation, application, and safety precautions shall strictly follow manufacturer's instructions.
 2. Standard Lining: Unless noted otherwise in the pipe material schedule, ductile iron pipe, fittings, and specials shall have an interior protective lining of cement-mortar with a seal coat of asphaltic material in accordance with ANSI/AWWA A21.4/C104.
 3. Exterior Coatings: Where ductile iron pipe and fittings are to be below ground or installed in a casing pipe the exterior coating shall be a minimum 1.0 mil thick in accordance with ANSI/AWWA A21.51/C151.

4. Exterior Coating for Exposed Pipe: Ductile iron pipe, fittings, and specials to be installed aboveground shall be furnished with a shop applied primer on the exterior. The shop primer shall be as specified in Section 09 90 00: Painting.
- C. Fittings: Fittings for ductile iron pipe shall be either mechanical joint, restrained joint, or flanged joint as indicated on the Drawings and shall have a minimum working pressure of 350 psi. Fittings shall be ductile iron and shall conform to ANSI/AWWA C110/A21.10, ANSI/AWWA C111/A21.11 and ANSI/AWWA C153/A21.53, latest revisions for flanged and mechanical joint pipe. Fittings shall be coated and lined in the manner specified above for ductile iron pipe. The rubber gaskets for flanged, mechanical, and push-on joints shall be as described below.
- D. Push-On Joints: Pipe using push-on joints shall be in strict accordance with ANSI/AWWA C111/A21.11, latest revision and shall be as manufactured by American Cast Iron Pipe Company (Fastite Joint), United States Pipe Company (Tyton Joint), or Clow Corporation (Super Bell Tite Joint). Jointing materials shall be provided by the pipe manufacturer and installation shall be in strict accordance with the manufacturer's recommended practice. For process air service, joint materials shall be rated for an operating temperature of at least 300° F.
- E. Mechanical Joints: Jointing materials for mechanical joints shall be provided by the pipe and fitting manufacturer. For process air service, joint materials shall be rated for an operating temperature of at least 300° F. Materials assembly and bolting shall be in strict accordance with ANSI/AWWA C111/A21.11 and ANSI/AWWA C153/A21.53, latest revisions. Tee head bolts and nuts for mechanical joints shall be manufactured of 316 stainless steel.
- F. Flanged Joints: Flanges shall be Class 125 per ANSI B16.1 with any special drilling and tapping as required to insure correct alignment and bolting.
 1. Gaskets:
 - a. Liquid Service: Fullface, 1/8-inch thick, cloth-inserted rubber: Johns-Manville No. 109, John Crane Co., Style 777, or equal. Gaskets shall be suitable for a water pressure of 350 psi at a temperature of 180°F.
 2. Bolts, nuts, and washers for flanges shall be of 316 stainless steel.
 3. Flanges shall be long-hub type screwed tightly on pipe by machine at the foundry prior to facing and drilling. Flange machine surfaces shall be coated with rust inhibitor immediately after facing and drilling. Field assembled screwed on flanges are prohibited.

- G. Restrained Joints and Fittings: Pipe joints and fittings shall be restrained in accordance with the Drawings and the requirements of this Specification. In cases where the calculated required length of restrained pipe is not evenly divisible by nominal laying lengths of pipe, the total required length of restrained pipe shall be rounded up to the next closest nominal length that is evenly divisible by the standard laying length.
1. Manufactured Restrained Joints: Manufactured restrained joints shall be Flex-Ring, Lok-Ring, or Lok-Fast manufactured by the American Cast Iron Pipe Company, Lok-Tyte or TR-Flex Type manufactured by the United States Pipe Company, or an equal approved by the Engineer.
 2. Restrained joint pipe and fittings shall be ductile iron only and shall comply with applicable portions of this Specification. Manufactured restrained joints shall be capable of deflection during assembly. Deflection shall not exceed 75 percent of the manufacturer's recommendations.
 3. Tee head bolts and nuts for restrained joints shall be 316 stainless steel.
- H. Alternate Restrained Joints: Ductile iron pipe and fittings with mechanical joints may be restrained using a follower gland which includes a restraining mechanism. When actuated during installation, the restraining device shall impart multiple wedging action against the pipe wall which increases resistance as internal pressure in the pipeline increases.
1. The joint shall maintain flexibility after installation. Glands shall be manufactured of ductile iron conforming to ASTM A536 and restraining devices shall be of heat treated ductile iron with a minimum hardness of 370 BHN. The gland shall have standard dimensions and bolting patterns for mechanical joints conforming to ANSI/AWWA C111 and C153, latest revisions.
 2. Tee head bolts and nuts shall be manufactured of corrosion-resistant, high strength, 316 stainless steel.
 3. The restraining wedges shall have twist-off nuts to insure proper torquing. The mechanical joint restraint device shall have a minimum working pressure rating of 250 psi with a minimum safety factor of 2 to 1 and shall be MEGALUG as manufactured by EBBA Iron, Inc.
 4. The following restrained joint systems are acceptable alternatives to the devices specified above:
 - a. Grip Ring as manufactured by Romac Industries, Inc.

- b. MJ Field Lok as manufactured by Tyler Pipe.
- c. StarGrip as manufactured by Star Pipe Products.
- d. One-Lok as manufactured by Sigma Corporation.

2.2 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

- A. Small Gravity Drainage Piping: PVC pipe smaller than 4 inches nominal diameter used for gravity drainage piping shall be Schedule 40 pipe in accordance with ASTM D1785. Schedule 40 PVC pipe shall have solvent welded joints as specified for PVC pressure pipe.
- B. Gravity Sewer Piping
 - 1. Polyvinyl Chloride (PVC) gravity sewer pipe and fittings 4-inches through 15-inches in size shall conform to ASTM D-3034, "Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings," SDR 26. Uniform minimum "pipe stiffness" at five (5) percent deflection shall be 46 psi.
 - 2. The supplier shall be responsible for the performance of all inspection and testing requirements specified in ASTM D-3034. Complete records of inspections, examinations and tests shall be kept and submitted to the Engineer. The Owner reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure that materials and services conform to the prescribed requirements.
 - 3. Pipe shall be joined with integral bell and spigot type rubber gasketed joints in accordance with ASTM D-3212. Each integral bell joint shall consist of a formed bell with a rubber gasket. Gaskets shall conform to ASTM F-477. Joints shall permit contraction, expansion and settlement, and yet maintain a watertight connection.
 - 4. Pipe shall be furnished in standard laying lengths not exceeding twenty (20) feet. Minimum standard length of pipe shall be thirteen (13) feet.
 - 5. All fittings and accessories shall be furnished by the pipe supplier and shall have bell and/or spigot configurations compatible with the pipe.
 - 6. All gaskets shall be factory installed.
 - 7. All PVC pipe for gravity sewers shall be green in color.
- C. Small PVC Pressure Piping: Unless otherwise specified, PVC pressure pipe smaller than 4 inches nominal diameter shall be Schedule 80 PVC in accordance with ASTM D1785. Schedule 80 pipe shall have either solvent welded or threaded joints. PVC pressure pipe shall bear the approved seal of

the National Sanitation Foundation (NSF). PVC pipe that is exposed to sunlight shall be manufactured with additives to provide resistance to ultraviolet deterioration.

1. Fittings: Socket type, solvent welded fittings for Schedule 80 PVC pipe shall be in conformance with ASTM D2467. Threaded type fittings for Schedule 80 PVC pipe shall be in conformance with ASTM D2464. All solvent welded or threaded joints shall be watertight.
2. Flanges: Flanges for Schedule 80 PVC pipe shall be rated for a 150 psi working pressure with ANSI B 16.1 dimensions and bolting pattern. Flanges shall be connected to PVC piping with either solvent welded or threaded joints in accordance with ASTM D2467 or ASTM 2464, respectively. Gaskets shall be neoprene, full faced type with a minimum thickness of 1/8-inch. Nuts and bolts shall be hexagonal with machine threads, manufactured of Type 316 stainless steel in accordance with ASTM A320, Class 2. Type 316 stainless steel flat washers, with lock washers, shall be used against PVC flanges. The nuts shall have a hardness that is lower than that of the bolts and washers by a difference of 50 Brinnell hardness to prevent galling during installation.
3. Solvent Cement: PVC solvent cement shall be in compliance with ASTM D2564 and in accordance with the pipe manufacturer's recommendations.
4. Thread Lubricant: Lubricant for Schedule 80 threaded joints shall be Teflon tape only.

D. Large PVC Pressure Piping

1. PVC pipe 4 through 12 inches in size shall conform to AWWA C900. Such pipe shall have a Dimension Ratio (DR) of either 18 or 25 depending upon the application indicated in the Drawings. The pressure rating for DR18 pipe shall be 150 psi and the pressure rating of DR25 pipe shall be 100 psi. PVC pipe shall have the same outside diameter as ductile iron pipe for each pipe size.
2. PVC pipe larger than 12 inches in size shall conform to AWWA C905. Such pipe shall have a Dimension Ratio (DR) of either 18 or 25 depending upon the application indicated in the Drawings. The pressure rating for DR18 pipe shall be 235 psi and the pressure for the DR25 pipe shall be 165 psi. PVC pipe shall have the same outside diameter as ductile iron pipe for each pipe size.
3. Fittings shall be ductile iron fittings with mechanical joint ends as specified herein.
4. Bell and Spigot: Pipe joints shall be made with integral bell and spigot

pipe ends. The bell shall consist of an integral thickened wall section designed to be at least as strong as the pipe wall. The bell shall be supplied with a factory glued rubber ring gasket which conforms to the manufacturer's standard dimensions and tolerances. The gasket shall meet the requirements of ASTM F477 "Elastomeric Seals (Gaskets) for Joining Plastic Pipe". PVC joints shall be "Ring-Tite" as manufactured by J-M Manufacturing Company, Inc. or an equal approved by the Engineer.

5. Restrained Joints: Where indicated on the Drawings, to prevent pipe joints and fittings from separating under pressure, pipe joints and fittings shall be restrained as follows:
 - a. PVC pipe bell and spigot joints shall be restrained with the EBBA Iron MEGALUG[□] Series 1500 Restrainer or an equal approved by the Engineer. The restraining device and tee head bolts shall be manufactured of high strength ductile iron meeting ASTM A536, Grade 6542-10. Clamping bolts and nuts shall be manufactured of high strength, 316 stainless steel. The following systems are acceptable alternatives to the devices specified above:
 - i. Romac Industries, Inc. Style 470SJ and Style 611.
 - ii. Star Pipe Products Series 1100C and Series 1200C.
 - iii. Sigma Corporation PV-LOK Series PVP.
 - iv. Ford Uni-Flange Series 1350 and Series 1390.
 - b. Mechanical joint fittings used with PVC pipe shall be restrained with the EBBA Iron MEGALUG[□] Series 2000 PV Restrainer or an equal approved by the Engineer. The restraining device and tee head bolts shall be manufactured of high strength 316 stainless steel. Clamping bolts and nuts shall be manufactured of high strength, 316 stainless steel. The following systems are acceptable alternatives to the devices specified above:
 - i. Romac Industries, Inc. Style 470MJ and Style 612.
 - ii. Star Pipe Products PVC StarGrip and PVC Ring Lock.
 - iii. Sigma Corporation PV-LOK Series PVM.
 - iv. Ford Uni-Flange Series 1300.

2.3 STEEL PIPING AND FITTINGS

- A. All galvanized steel pipe shall be Schedule 40 pipe meeting the requirements

of ASTM A120. All pipe joints shall be threaded. Fittings shall be galvanized malleable iron fittings with a pressure rating of at least 150 psi.

2.4 FLANGED ADAPTER COUPLINGS

- A. Adapters shall be suitable for joining plain-end pipe to flanged pipes and fittings. Adapters shall conform in size and bolt hole placement to ANSI standards for steel and/or cast iron flanges, 125 or 150 pound standard, unless otherwise required for connections (ANSI B16.1 125 lb./ANSI B16.5 150 lb.).
- B. Adapters shall be constructed of steel and coated in accordance with Section 09 90 00. Bolts and nuts shall be Type 316 stainless steel conforming to ASTM A193, Grade B8 for bolts, and ASTM A194, Grade 8 for nuts and washers. Gasket material shall be suitable for exposure to the liquids to be contained within the pipes. All adapters shall be restrained with set screws to prevent axial movement. The restraint system shall be rated for a working pressure of at least 150 psi.
- C. Adapters shall be Dresser Style 128 or equal.

2.5 PLUG VALVES

- A. Plug valves shall be non-lubricated 100% full port eccentric type with flanged or mechanical joint ends as specified below. Valves shall open by turning to the left (counter-clockwise), when viewed from the stem. Valve pressure ratings, body flanges, and wall thicknesses shall be in full conformance with ANSI B16.1, latest revision. Valves shall seal leak-tight against full rated pressure in both directions. Prior to shipment from the factory, each valve shall be hydrostatically tested as follows. Valve seats shall be tested to provide leak tight shut off to 175 psi for valves through 12-inch and 150 psi for valves 14 inches and larger, with pressure in either direction. In addition, a hydrostatic shell test shall be performed with the plug open to a pressure twice that of rating specified above to demonstrate overall pressure integrity of the valve body. Plug valves shall be eccentric plug valves as manufactured by DeZurik, Milliken, or an approved equal.
- B. Valve bodies shall be constructed of high strength cast iron conforming to ASTM A126, Class B and AWWA C504, latest revisions. Valve seats shall be formed by cast bodies with raised eccentric seats which have a corrosion-resistant welded-in overlay of not less than 90 percent pure nickel on all surfaces contacting the plug face. Valve seats shall be in accordance with AWWA C504 and AWWA C507, latest revisions. Valves shall be furnished with resilient faced plugs with neoprene facing, suitable for use with sludge. Valves shall be furnished with replaceable, permanently lubricated, stainless steel or fiberglass backed woven teflon fiber, sleeve-type bearings in the upper and lower plug stem journals. Plug stem bearings shall comply with AWWA C504 and C507,

latest revisions.

Valves shall be bolted bonnet design. Valves shaft seals shall be designed so that they can be repackaged without removing the bonnet and the packing shall be adjustable. Packing material shall be Buna-Vee type packing. Valve shaft seals shall be in accordance with AWWA C504 and AWWA C507, latest revisions. All exposed valve nuts, bolts, springs, washers, and the like shall be Type 316 stainless steel.

- C. All interior ferrous surfaces of the valve, except the valve seating surfaces, shall be coated with a factory applied, fusion bonded or thermosetting epoxy coating in accordance with AWWA C550, latest revision. Coating shall be holiday-free with a minimum thickness of 12 mils. Surfaces shall be clean, dry, and free from rust, oil, and grease before coating.
- D. All exterior surfaces of plug valves shall be clean, dry, and free from rust and grease before coating. For buried service, the exterior ferrous parts of all valves shall be coated at the factory. For valves installed aboveground, the exterior ferrous parts of all valves shall be shop primed at the factory with one coat, minimum dry film thickness 2 - 3.5 mils, of a lead and chromate-free primer with rust-inhibitive pigments and synthetic resins. Primer shall be suitable for finish paint specified. Following installation, above-ground valves shall be finish painted in accordance with Section 09900: Painting.
- E. All plug valves installed above ground, in valve vaults, or on flanged piping shall have flanged ends as specified for ductile iron pipe. Flanges shall comply with facing, drilling, and thickness of ANSI Standards for Class 125 dimension. All buried plug valves shall have mechanical joint ends as specified for ductile iron pipe.
- F. Mechanical Valve Actuators
 - 1. Each plug valve installed underground shall have a gear actuator with a 2- inch square nut designed for buried and submerged service. Gear actuator shall be sized for the maximum pressure differential across the valve, equal to the pressure rating of the valve. Valve shall have seals on all shafts and gaskets on valve and actuator covers to prevent entry of water and dirt. Actuator mounting brackets for buried or submerged service shall be totally enclosed and shall have gasket seals. All exposed valve nuts, bolts, springs, washers, and the like shall be Type 316 stainless steel.
 - 2. Each aboveground plug valve and all plug valves installed in concrete vaults shall be furnished with a mechanical gear actuator furnished with a handwheel. Gear actuator shall be sized for the maximum pressure differential across the valve, equal to the pressure rating of the valve. All gearing shall be enclosed in a high-strength cast iron housing, suitable for running in a lubricant. Housing shall be

provided with seals on all shafts to prevent the entry of dirt and water into the actuator. Actuator shaft and quadrant shall be supported on permanently lubricated bronze bearings. Actuator shall clearly indicate valve position and an adjustable stop shall be provided to set closing torque.

2.6 SWING CHECK VALVES

- A. Swing check valves 2-inch through 24-inch in size shall conform to AWWA C508, latest revision, and shall be designed for a minimum water working pressure of 150 psi. Check valves shall have cast iron body, swing type design, and ends shall be flanged, Class 125 in accordance with ANSI B16.1. When open, the valve shall have a straight way passage with a minimum flow area equal to the full pipe area. Swing check valves shall be completely bronze fitted with renewable bronze seat ring and a rubber faced disc. Valve hinge pin shall be stainless steel. Check valves shall be supplied with an outside lever and spring. The check valve bonnet shall be provided with a tapped boss with plug for future installation of a pressure gauge.
- B. Swing check valves shall absolutely prevent the return of water back through the valve when the inlet pressure decreases below the downstream pressure. The check valve shall be constructed such that the disc and body seat ring may be easily removed and replaced without removing the valve from the line. Each valve shall be hydrostatically tested at the factory, at a test pressure of 300 psi.
- C. Prior to shipment from the factory, the interior ferrous surfaces of the valve, except for finished, non-ferrous, or bearing surfaces, shall be coated with a fusion bonded or thermosetting epoxy coating in accordance with AWWA C550, latest revision. Coating shall be holiday-free, NSF approved, with a minimum thickness of 16 mils. Surfaces shall be clean, dry, and free from rust and grease before coating.
- D. All exterior surfaces of swing check valves shall be clean, dry, and free from rust and grease before coating. Exterior ferrous parts of all valves shall be shop primed at the factory with one coat, minimum dry film thickness of 4 mils, of a rust inhibitive, universal primer. Primer shall suitable for finish paint specified. Following installation, valves shall be finish painted in accordance with Section 09 90 00: Painting.
- E. Valve Manufacturer: Swing check valves shall be manufactured by Kennedy, M&H, Mueller, or an approved equal.

2.7 AIR RELEASE VALVES

- A. Air Release Valves for Wastewater Service

1. Sewage Combination Air Valves (SCAV)

a. Design: Single body, double orifice to allow large volumes of air to escape or enter pipe.

- 1) Maximum Operating Pressure: 250 PSI (17.2 Bar)
- 2) Operating Range: 0 – 250 PSI (0 - 17.2 Bar)
- 3) Valve seat does not contact the medium (air cushion).
- 4) Two connections for effective flushing during maintenance work (top inlet flushing connection)
- 5) All mechanical parts are manufactured of corrosion-resistant materials; valve body is stainless steel 316Ti

b. Materials:

No.	Component	Series - Stainless Steel
1	Outlet elbow with strainer, 1,5"	Polyethylene (PE) 100
2	Cup seal with retaining ring	Buna NBR
3	O-ring 79 x 7 mm	Buna NBR
4	Hex Head Bolt	Stainless Steel
5	Hexagon nut	Stainless Steel
6	Deflector	Polyethylene (PE)
7	Body	Stainless Steel 316Ti
8	Float	Delrin® POM1
9	Ball valve, 1"	Stainless Steel
10	Float spindle, complete	Stainless Steel 316Ti
11	Body nut with grid	Delrin® POM1
12	Membrane holder, complete	Delrin® POM1
13	O-ring 157 x 6 mm.	Buna NBR
14	Clamping flange	Stainless Steel
15	Valve body & cover	Delrin® POM1
16	Valve basket with Buna N O-rings	Delrin® POM1
17	Threaded ring	Delrin® POM1
18	Pressure spring	Stainless Steel
19	Damper ring	Buna NBR

B. Valve End Connections:

1. Valves smaller than 4 inches shall have threaded ends. Valves 4 inches and larger shall have flanged ends.
2. Flanges for Class 150 valves shall comply with ANSI B16.1, Class 125. Flanges for Class 300 valves shall comply with ANSI B16.1, Class 250.

3. Threaded ends shall comply with ANSI B2.1.

C. Bolts and Nuts for Flanged Valves:

1. Bolts and nuts for flanged valves located outdoors above ground shall be Type 316 stainless steel conforming to ASTM A-193, Grade B8M or bolts, and ASTM A-194, Grade 8M for nuts.

D. Gaskets: Gaskets for flanged end valves shall be as described in the detail piping specifications.

E. Air release valves shall be manufactured by H-TEC Model 986 (stainless steel) or ARI 020 (stainless steel).

2.8 STAINLESS STEEL BALL VALVES

A. General Service: Stainless steel ball valves shall be full port type for the sizes indicated on the Drawings. Ball valves shall be designed for a working pressure of 200 psi with positive shut off when in the closed position. Valve body and ends shall be constructed of forged Type 316 stainless steel and valve ends shall be NPT threaded connections. The ball shall have a full bore port design machined from a solid metal piece with highly polished surfaces. The ball and stem shall be manufactured from Type 316 stainless steel. Manually operated ball valves shall be furnished with lever operators manufactured of forged Type 316 stainless steel with a molded vinyl sleeve. Stainless steel ball valves shall be Type 1000 Neles-Jamesbury screwed end ball valves, or an equal approved by the Engineer.

2.9 PRESSURE GAUGE ASSEMBLIES

A. Pressure gauges shall have the following design features: silicone oil filled, 4-inch aluminum dial with black numerals on white background, Type 316 stainless steel bourdon tube and internal movement, 330 Series stainless steel case and ring, safety glass lens, threaded lens retaining ring, adjustable pointer, either friction or gear adjustable, blowout protection, 1/2-inch Type 316 stainless steel stem mounting, and 1.0 percent accuracy based on full scale. No stop pins shall be permitted on the dial face. Internal stop pins shall be required to prevent the sector gear from becoming disengaged from the geared needle post as a result of over or under pressure range. Provide Type 316 stainless steel pressure snubbers on all gauges not protected by diaphragm seals. Provide a supply of replacement fill liquid for all gauges supplied for the entire Project. Pressure gauges shall be as manufactured by U.S. Gauge, Ashcroft, Marshalltown, Marsh, Wika, or approved equal.

B. Pressure Gauge Service and Ranges: Pressure gauges shall be furnished for the following services with the indicated ranges. This table is for the

Contractor's convenience only, and may not depict all systems or all services that require gauges.

<u>Service</u>	<u>Range</u>	<u>Diaphragm Seal</u>
Pump Discharge		0-50 psi
Yes		

- C. Each pressure gauge assembly shall be furnished with an isolation ball valve. Body, stem, and all other parts of valves shall be manufactured of Type 316 stainless steel. Valve packing shall be high-density TFE. Valve connections shall be 1/2-inch female NPT threaded connections. Ball valves for pressure gauge assembly isolation shall be 45 Series as manufactured by the Swaglok, or an equal approved by the Engineer.

2.10 WALL SLEEVES, SEALS, AND PIPES AND NON-STANDARD CASTINGS

A. Wall Sleeves:

1. Wall sleeves shall be of cast iron, ductile iron, or hot-dip galvanized carbon steel and shall have a waterstop ring located in the center of the wall. Sleeves shall be provided with seals and shall be oversized as required for the installation of seals. Sleeves shall terminate flush with finished surfaces of walls and ceilings, and shall extend 2 inches above the finished floor.
2. When noted on the Drawings, smaller pipe sleeves in CMU specified sand shall be oversized as required for the installation of the process pipe and sealant materials. Sleeves shall terminate flush with finished surfaces of walls and ceilings, and shall extend 2 inches above the finished floor.
3. For poured or grouted in place sleeves, lightweight, high-impact thermoplastic sleeves may be substituted. Plastic sleeves shall have an integral waterstop and anchoring ribs. Plastic sleeves shall be a product of the sleeve seal manufacturer and shall be Century Line Sleeves as manufactured by Thunderline Corporation or an approved equal.
4. Wall sleeves shall be installed for all piping passing through building walls and floors, except where noted on the Drawings. Sleeves shall be of sufficient size to pass the pipe without binding. Sleeves shall terminate flush with finished surfaces of walls and ceilings, and shall extend 2 inches above the finished floor. Escutcheons shall be provided at walls and floor to completely conceal the sleeves smaller than 3 inches. Escutcheons shall be cast iron, nickel plated split-type.

- B. Wall Sleeve Seals: Wall sleeve seals shall be modular mechanical type consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall sleeve. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut. After the seal assembly is positioned in the sleeve, tightening of the bolts shall cause the rubber sealing elements to expand and provide an absolutely water-tight seal between the pipe and wall sleeve. The synthetic rubber shall be suitable for exposure to water, wastewater, and groundwater. Pressure plates shall be of nylon polymer and bolts, nuts, and washers shall be Type 316 stainless steel. The seals shall be Link Seal as manufactured by Thunderline Corporation or an approved equal.

2.11 FLEXIBLE EXPANSION JOINTS

- A. Flexible expansion joints shall be of the molded wide double arch design manufactured of neoprene rubber with polyester and steel reinforcement. Neoprene body shall be supplied with a Hypalon coating. All expansion joints shall have filled arches. Joints shall be flanged, suitable for 150 psi water working pressure, and in accordance with ANSI B16.1 dimensions and bolting patterns. Flanged ends shall be furnished with split 316 stainless steel retaining rings.
- B. Provide 316 stainless steel limit restraint rods on all lines as follows:

Nominal psi Pipe Size (Inches)	150 psi		300	
	No. Bolts Or Studs	Size (Inches)	No Bolts Or Studs	Size (Inches)
2	2	5/8	2	5/8
3	2	5/8	2	5/8
4	2	5/8	2	5/8
6	2	5/8	2	5/8
8	2	5/8	2	5/8
10	2	5/8	2	3/4
12	2	3/4	2	7/8
14	2	3/4	2	1
16	2	7/8	2	1-1/4
18	2	1	2	1-3/8
20	2	1	2	1-1/2
24	4	1	4	1-1/4

- C. Minimum performance for flexible expansion joints shall be as follows:

Size	Axial Compressi on	Axial Elongatio n	Lateral Deflectio n	Angular Deflectio n
2	7/8	1/2	1	30

4	7/8	1/2	1	30
6	7/8	1/2	1	25
8	1-3/8	3/4	1	25
10	1-3/8	3/4	1	20
12	1-3/8	3/4	1	20
24	1-5/8	7/8	1	20

- D. Flexible expansion joints shall be as manufactured by Mercer, Red Valve, General Rubber Corporation, Metraflex Company, or an equal approved by the Engineer.

2.12 TRANSITION COUPLINGS

- A. Couplings to join ductile iron or standard steel pipe to stainless steel pipe shall be sleeve type units with epoxy coated steel bodies specifically designed for the intended service. The couplings shall have gaskets rated for at least 300° F and be sufficiently restrained against axial movement at a working pressure of 15 psi. Alternative couplings involving flanges are also acceptable. Couplings shall be manufactured by Dresser or an approved equal.

2.13 VALVE BOXES

- A. Furnish, assemble, and place a valve box over the operating nut for each buried valve. The valve box shall be designed so as to prevent the transmission of surface loads directly to the valve or piping.
- B. Valve boxes shall be of the adjustable slide-type of suitable length with an interior diameter of not less than 5 inches. The valve boxes shall be manufactured of cast iron and shall be of the two piece design including a bottom section and top section with cover. The cast iron cover shall be cast with the applicable service, "WATER", "REUSE", "SEWER", etc., markings. The top section shall be adjustable for elevation and shall be set to allow equal movement above and below finished grade. The tops of the valve boxes for the potable water mains and sanitary force mains shall be round. The tops of the valve boxes for reuse mains shall be square.
- C. The castings shall be manufactured of clean, even grain, gray cast iron conforming to ASTM A48, Class 30B for Gray Iron Castings; and shall be smooth, true to pattern, free from blow holes, sand holes, projections, and other harmful defects. The seating surfaces of both the cover and the top section shall be machined so that the cover will not rock after it has been seated.
- D. The valve boxes shall be coated inside and outside with an asphaltic coating prior to machining, so that the machined seating surfaces will be free of any coating. Valve extension stems shall be provided for all buried valves when

operating nut is deeper than 3 feet below final grade.

- E. Valves boxes shall be manufactured by Tyler, American Flow Control, Rusco, or an approved equal.

2.14 TAPPING SLEEVES AND VALVES

- A. Mechanical joint tapping sleeves shall be full body ductile-iron and have an outlet flange with the dimensions of the Class 125 flanges shown in ANSI B16.1, properly recessed for tapping valve. Glands shall be ductile iron. Gaskets shall be vulcanized natural or synthetic rubber. Bolts and nuts shall comply with ANSI/AWWA C111/A21.11. Sleeves shall be capable of withstanding a 200 psi working pressure.
- B. Steel tapping sleeves shall be fabricated of minimum 3/8" carbon steel meeting ASTM A285 Grade C. Outlet flange shall meet AWWA C-207, Class "D" ANSI 150 lb. drilling and be properly recessed for the tapping valve. Bolts and nuts shall be high strength low alloy steel, meeting AWWA C111 (ANSI A21.11). Gasket shall be synthetic rubber. Sleeve shall have manufacturer applied fusion bonded epoxy coating, minimum 12 mil thickness. Steel tapping sleeves shall be manufactured by JCM or an approved equal.
- C. Tapping valves shall be resilient wedge gate valves meeting the requirements as specified herein; however, the end configuration shall be compatible with the tapping sleeve.

2.15 REDUCED-PRESSURE BACK FLOW PREVENTERS

- A. Reduced-pressure back flow preventers shall be installed per latest OUC Standards and shall be completely lead free.

2.16 HDPE PRESSURE PIPE

- A. Qualifications: All polyethylene pipe, fittings and appurtenances shall be furnished by a single manufacturer who is fully experienced, reputable and qualified in the manufacture of the items to be furnished.
- B. Polyethylene pipe shall be high-density PE 3408 polyethylene resin per ASTM D 3350, Cell Classification 345464C, Class 160, DR 11, CPChem DriscoPlex 4000, 4300 or 4500 or an approved equal, meeting the requirements of AWWA C906. All pipe materials used in potable water systems shall comply with NSF Standard 61. Outside diameters of water, claimed water and pressure sewer HDPE pipes shall be ductile iron size (DIPS).
- D. Joints: Where PE pipe is joined to PE pipe, it shall be by thermal butt fusion. Thermal fusion shall be accomplished in accordance with the written instructions of the pipe manufacturer and fusion equipment supplier. The installer of the

thermal butt fused PE pipe shall have received training in heat fusion pipe joining methods and shall have had experience in performing this type of work. Where thermal butt fusion cannot be used, or when specifically called for on the plans, electro-fused couplings may be used. Fusion shall be in accordance with the written instructions of the fitting manufacturer. Flanged joints, mechanical joints, tapping saddles, and molded fittings shall be in accordance with AWWA C901, C906 or C909, ASTM D3350 and D3140, as applicable. Fusion and mechanical connections are allowed, chemical (solvents, epoxies, etc.) are not allowed.

- E. Detection: Direct buried HDPE pipe shall have 3" detectable metallic tape of the proper color placed directly above the pipe and 12" below finished grade or 6" detectable tape between 12" and 24" below finished grade. Direct buried or horizontal directional drilled HDPE pipe shall also have tracer wire installed along the pipe alignment. The tracer wire to be used shall be a solid, 10 gauge, high strength, copper clad steel wire with a polyethylene jacket of appropriate color manufactured by Copperhead Industries or approved equal.
- F. Identification: Pipe shall bear identification markings in accordance with AWWA C906. Pipe shall be color coded blue for water, purple (Pantone 522 C) for reclaimed water or green for pressure sewer using a solid pipe color or embedded colored stripes. Where stripes are used, there shall be a minimum of three stripes equally spaced.
- G. Installing Polyethylene Pressure Pipe and Fittings
All polyethylene pressure pipe shall be installed by direct bury, or directional bore. If directional bore is used the entire area of construction shall be surrounded by silt barriers during construction.

2.16 COPPER TUBING

- A. Material: Copper tubing conforming to federal specifications WW-T-99 (ASTM B88-47).
- B. Design: Soft annealed, type K, self-tempered, 250psi test. Size determined by outside diameter (O.D.).
- C. Special Features: Tubing must be delivered with circumference over the entire length sufficient to receive CTS fittings. Tubing may not be egg shaped, flattened or damaged in any way.

PART 3 - EXECUTION

3.1 INSPECTION

- A. All pipe, fittings, valves, and other material shall be subject to inspection and approval by the Engineer after delivery, and no broken, cracked, imperfectly coated, or otherwise damaged or unsatisfactory material shall be used. When a defect or crack is discovered, the damaged portion shall not be installed.

Cracked pipe shall have the defect cut off at least 12 inches from the break in the sound section of the barrel.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Excavation, backfill, and compaction shall conform to the provisions of Section 31 00 00, Earthwork. Upon satisfactory installation of the pipe bedding material as specified in Section 31 00 00, a continuous trough for the pipe barrel and recesses for the pipe bells or couplings shall be excavated by hand digging. When the pipe is laid in the prepared trench, true to line and grade, the pipe barrel shall receive continuous, uniform support and no pressure will be exerted on the pipe joints from the trench bottom.
- B. Cover for underground piping shall not be less than that indicated on the Drawings. The minimum cover for pipe shall be 36 inches. In areas where other piping conflicts preclude the cover desired, the piping shall be laid to provide the maximum cover obtainable.
- C. Pipe, fittings, valves, and accessories shall be installed as shown or indicated on the Drawings.
- D. All connections to existing piping systems shall be made as shown or indicated on the Drawings after consultation and cooperation with authorities of the Owner. Some such connections may have to be made during off-peak hours (late night or early morning).
- E. Pipe Joint Deflection: Whenever it is desirable to deflect pipe joints to avoid obstructions or to maintain required alignment, the amount of the joint deflection shall not exceed 75 percent of the maximum limits allowed by the pipe manufacturer.
- F. In preparation for pipe installation, placement (stringing) of pipe should be as close to the trench as practical on the opposite side of the trench from the excavated material. The bell ends of the pipe should point in the direction of the work progress.
- G. Pipe and fittings shall be laid accurately to the lines and grades indicated on Drawings. Where grades for the pipeline are not indicated on the Drawings, maintain a uniform depth of cover with respect to finish grade. Care shall be taken to insure a good alignment both horizontally and vertically and to give the pipe a firm bearing along its entire length. Any pipe which has its grade or joint disturbed after laying shall be taken up and relayed.
- H. All pipe and fittings shall be cleared of sand, dirt, and debris before laying. All precautions shall be taken to prevent sand, dirt, 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 sand, dirt, or other foreign material that enters the pipe shall be removed from the pipe immediately. Interior of all pipe and fittings shall be kept clean after installation until accepted in the complete Work.

- I. Any time that pipe installation is not in progress, the open ends of 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. No pipe shall be installed when trench conditions are unsuitable for such work, including standing water, excess mud, or rain.
- J. After pipe has been laid, inspected, and found satisfactory, sufficient backfill shall be placed along the pipe barrel to hold the pipe securely in place while conducting the preliminary hydrostatic test. No backfill shall be placed over the joints until the preliminary test is satisfactorily completed, leaving them exposed to view for the detection of visible leaks.
- K. Upon satisfactory completion of the hydrostatic test, backfilling of the trench shall be completed.
- L. Above-Ground and Exposed Piping: Piping shall be cut accurately to measurements established at the job site and shall be worked into place without springing or forcing, properly clearing all equipment access areas and openings. Changes in sizes shall be made with appropriate reducing fittings. Pipe connections shall be made in accordance with the details shown and manufacturer's recommendations. Open ends of pipelines shall be properly capped or plugged during installation to keep dirt and other foreign material out of the system. Pipe supports and hangers shall be provided where indicated or as required to insure adequate support of the piping.

3.3 INSTALLATION OF DUCTILE IRON PIPE

- A. All ductile iron pipe and fittings shall be laid in accordance with American Water Works Association Standard ANSI/AWWA C600, latest revision, entitled "Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances".
- B. Restrained Joints: Restrained joints shall be provided where indicated on the Drawings. Joint assembly shall be made in strict accordance with the manufacturer's instructions, which shall be submitted to the Engineer for review and approval before commencing work.
- C. Flanged Joints: Flanged joints shall be made up by inserting the gasket between the flanges. The threads of the bolts and the faces of the gaskets shall be coated with suitable lubricant immediately before installation.

- 1. Bolt holes of flanges shall straddle the horizontal and vertical

centerlines of the pipe. Clean flanges by wire brushing before installing flanged fittings. Clean flange bolts and nuts by wire brushing and lubricate bolts with oil and graphite.

2. Insert the nuts and bolts (or studs), finger tighten, and progressively tighten diametrically opposite bolts uniformly around the flange to the proper tension.
3. Exercise care when tightening joints to prevent undue strain upon valves, pumps, and other equipment.
4. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reset or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

3.4 INSTALLATION OF SMALL DIAMETER PVC PIPE

- A. All push-on joint PVC pipe shall be installed in accordance with the pipe manufacturer's published installation guide, the AWWA Manual of Practice No. M23 "PVC Pipe - Design and Installation" and the Uni-Bell Plastic Pipe Association installation recommendations.
- B. PVC Pipe Joint Assembly for Threaded and Solvent Welded Pipe:
 1. All threaded and solvent welded joints shall be made watertight in accordance with ASTM D2855, ASTM D2564, and AWWA Manual M23. All pipe cutting, threading, and jointing procedures for threaded and solvent welded PVC pipe joints shall be in strict accordance with the pipe and fitting manufacturer's printed installation instructions. Thread lubricant for threaded joints shall be Teflon tape only.
 2. At threaded joints between PVC and metal pipes, the metal side shall contain the socket end and the PVC side the spigot. A metal spigot shall not, under any circumstances, be screwed into a PVC socket.

3.5 INSTALLATION OF GRAVITY SEWER PIPING

- A. Workmanship: Sewers and appurtenances shall be built watertight. The sewage must be pumped for disposal and special care and attention must be paid to securing watertight construction. Upon completion, the sewers, or sections thereof, will be tested and gauged and if leakage is above the allowable limits specified, the sewer will be rejected.
- B. Inspection: On completion of each block or section of sewer, or such other times as the County may direct, the block or section of sewer shall be cleaned, tested, and inspected.

1. Each section of the sewer shall show, on examination from either end, a full circle of light between manholes.
 2. Each manhole or other appurtenance to the system shall be of the specified size and form, be watertight (no leakage allowed), and be constructed with the top set permanently to specified position and grade. All repairs shown necessary by the inspection shall be made; broken or cracked pipe replaced; all deposits removed and the sewer left true to line and grade, entirely clean and ready for use.
 3. No pipe shall exceed a deflection of 5%. After the final backfill has been in place at least 30-days, the Contractor shall perform deflection testing using a rigid ball or mandrel with a diameter of not less than 95% of the base inside diameter or average inside diameter of the pipe, depending which is specified in the ASTM standard to which the pipe is manufactured. If the mandrel does not pass the completed section of sewer, the entire section of sewer will be rejected.
- C. Low Pressure Air Exfiltration Testing: Refer to Section 33 05 05.33: Low Pressure Air Testing of Installed Sewer Pipe.

3.6 INSTALLATION OF PIPE SLEEVES, WALL CASTINGS, AND COUPLINGS

- A. Pipe sleeves and wall castings shall be provided at the locations called for on the Drawings. These units shall be as detailed and of the material as noted on the Drawings. They shall be accurately set in the concrete or masonry to the elevations shown. All wall sleeves and castings required in the walls shall be in place when the walls are poured. Ends of all wall castings and wall sleeves shall be of a type consistent with the piping to be connected to them.
- B. Link seals for wall sleeves shall be installed in strict accordance with the manufacturer's printed installation instructions. For watertight applications in tanks, the link seal installation shall be tested hydrostatically for leaks at the same time as the tank. Any leaks that occur during the test period shall be repaired by checking the link seals for proper installation and replacing of units found to be defective at no additional cost to the Owner.
- C. Pipe couplings shall be installed in strict accordance with the manufacturer's published instructions and recommendations.

3.7 INSTALLATION OF VALVES

- A. Valves of the size and type shown on the Drawings shall be set plumb and installed at the locations indicated on the Drawings. Valves shall be installed in accordance with manufacturer's installation instructions and with the details shown on the Drawings.

- B. Valves shall be installed such that they are supported properly in their respective positions, free from distortion and strain. Valves shall be installed such that their weight is not borne by pumps and equipment that are not designed to support the weight of the valve.
- C. Valves shall be carefully inspected during installation; they shall be opened wide and then tightly closed and the various nuts and bolts shall be tested for tightness. Special care shall be taken to prevent any foreign matter from becoming lodged in the valve seat. Check and adjust all valves for smooth operation.
- D. Install valves with the operating stem in either horizontal or vertical position.
- E. Allow sufficient clearance around the valve operator for proper operation.
- F. Clean iron flanges by wire brushing before installing flanged valves. Clean carbon steel flange bolts and nuts by wire brushing, lubricate flange bolt threads with oil or graphite, and tighten nuts uniformly and progressively. Clean threaded joints by wire brushing or swabbing. Apply Teflon joint compound or Teflon tape to pipe threads before installing threaded valves. Joints shall be watertight.
- G. For buried valves, a valve box shall be centered accurately over the operating nut and the entire assembly shall be plumb. The tops of valve boxes shall be adjusted to the proper elevation as specified below and as shown on the Drawings.
- H. Valves shall be tested hydrostatically, concurrently with the pipeline in which they are installed. Protect or isolate any parts of valves, operators, or control and instrumentation systems whose pressure rating is less than the pressure used for the pressure tests. If valve joints leak during pressure testing, loosen or remove the nuts and bolts, reseal or replace the gasket, reinstall or retighten the bolts and nuts, and hydrostatically retest the joints.
- I. Following installation, all above-ground valves shall be painted in accordance with the painting system specified in Section 09 90 00: Painting.

3.8 HYDROSTATIC PRESSURE AND LEAKAGE TESTING - See Section 33 05 05.31

3.9 OBTAINING POTABLE WATER FOR TESTING AND FLUSHING

- A. The potable water supply shall be protected with an air gap or a reduced pressure principle backflow preventer approved by the Owner, if potable water is used for testing and flushing.
- B. To obtain potable water service during construction, the Contractor shall be

required to install a temporary water meter, if public supply is available. The piping, fittings, backflow preventer, and appurtenances required for the temporary construction water service shall be supplied by the Contractor.

- C. The Contractor shall coordinate with the Owner for temporary construction water service connection, usage, and flushing.

3.10 INSTALLATION OF REDUCED PRESSURE BACK FLOW PREVENTERS

- A. Back flow preventers shall be installed at the locations shown on the Drawings. Back flow preventers shall be installed in accordance with the manufacturer's written installation instructions and as shown on the Drawings.
- B. Reduced pressure principle back flow preventers shall be installed horizontally with an 18-inch minimum clearance between the finished grade and the lowest point on the bottom of the unit. Reduced pressure back flow preventers shall be installed with provisions for a suitable drain arrangement to drain off discharges from the relief valve, so that discharges are not objectionable. Back flow preventers shall be installed such that they are easily accessible for testing, maintenance, and repair.
- C. Piping and fittings for units 3 inches and larger in size shall have flanged joints. Piping, fittings, and valves for units 3 inches and larger in size shall be properly supported with adjustable pipe support stands as shown on the Drawings.
- D. Following installation of the reduced pressure back flow preventer, piping, fittings, valves, and the entire above ground assembly shall be finish painted in accordance with Section 09 90 00: Painting.

3.11 MAIN CLEANING AND FLUSHING

- A. Following the hydrostatic and leakage tests, all the mains constructed under this contract shall be cleaned and flushed to remove sand, loose dirt, and other debris. Flushing velocity shall be a minimum of 2.5 fps. Flushing shall continue until clean water flows from the main. However, the Contractor shall endeavor to use the minimum amount of flushing water required to complete the work.
- B. Upon completion of testing for the gravity drain line system, drain lines shall be flushed to remove dirt, sand, stones, and other debris which may have entered the lines during construction and settled out in the lines. Materials and debris flushed from the drain lines shall be removed from a downstream lift station and disposed of at an approved disposal area.
- C. Temporary blowoffs may be required for the purpose of flushing mains. Temporary blowoffs shall be installed as close as possible to the ends of the main being flushed. Blowoffs installed on the main shall be the same diameter as the main. Temporary blowoffs shall be removed and plugged after the main is

flushed. All costs for installing and removing temporary blowoffs shall be at no additional cost to the Owner.

- D. The Owner shall be notified at least 72 hours prior to flushing mains.
- E. Blowoffs and temporary drainage piping used for flushing shall not be discharged into any gravity sewer or pumping station wetwell. The Contractor shall obtain prior approvals from the Engineer and the Owner as to the methods and locations of flushing water discharge.

3.12 PIGGING

- A. Use a pipeline pigging device of the proper size designed to clean the intended pipeline. The pigging device shall be capable of turning through a standard 90 degree MJ bend. The type of pipeline pigging device and the method of operation shall be included in a pipeline pigging plan and submitted to the Owner for approval. The pigging plan shall require swab type B1 or equal. A minimum of three swabs shall be used for each section/run to be pigged. The three swabs shall not be inserted at the same time unless there is sufficient distance between them to inhibit contact. The next size swab larger than the pipe size shall be used. Any insertion or removal fitting that will remain in the water system shall be noted on as-built drawings indicating the type and location. Contractor shall include all auxiliaries, temporary fittings, plugs, etc. necessary to complete pigging of pipelines. Contractor shall TV inspect lines after pigging to determine if lines have been successfully cleaned.

3.13 CONNECTION TO EXISTING WATER AND WASTEWATER SYSTEMS

- A. The Contractor shall coordinate making connection of the new mains to mains, which are in service at the time of construction with the Owner. The Contractor shall not connect to existing facilities unless the Engineer and a representative of the Owner are present. The Engineer and the Owner shall be notified at least 48 hours prior to the time connection is desired.
- B. Operation of all system valves shall be the responsibility of the Owner's personnel only. At no time shall the Contractor operate any system valves. System valves shall be defined as any valve which has main pressure against either side of the valve. The Contractor shall notify the Owner to request that a valve be operated, at least 48 hours prior to the time operation is required.

3.14 TRAINING

- A. After completion of the field certification and testing, a minimum of three (3) separated four (4) hour operator instruction and training sessions on equipment and system operation shall be provided. Contractor shall provide a proposed list of dates and times to hold the training sessions to the Owner at least (3) three weeks prior to the proposed dates, Owner must approve times prior to final scheduling the training. The training shall provide a complete

overview of all equipment, testing, adjusting, operation, and maintenance procedures. The training shall take the form of classroom sessions at the project site conducted by the manufacturer or local representatives who are knowledgeable and familiar with the project. Hands- on instruction and training will be conducted so that actual operation and maintenance of the equipment and systems can be performed by Owner upon completion of the training. Training shall be provided to the owner prior to final system start up. The training shall take the form of classroom and field instruction and shall cover:

1. Documentation in the final Operation and Maintenance Manuals.
2. Use the Operation and Maintenance Manuals or other guides.
3. Equipment and system startup and shutdown.
4. System operation procedures for all modes of operation.
5. Procedures for dealing with abnormal conditions and emergency situations for which there is a specified system response.
6. Any and all special tools, equipment training manuals used during the training shall be the property of the OWNER upon completion of the training.

3.14 Permits and Associated Fees

- A. Contractor is responsible to obtain all permits required and pay for the associated fees.

END OF SECTION

SECTION 33 05 05.31 – PRESSURE TESTING OF PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope of Work: This Section specifies the hydrostatic testing requirements for utility piping. Hydrostatic pressure and leakage testing shall be completed in accordance with AWWA C600 and C605, latest revision, however, no leakage is allowed. Additionally, all testing shall be in accordance with the latest standards in effect at the time of bidding that are required by the City of Orlando and OUC. If any information in these specifications differs from that of those agency standards listed above, the most stringent standard shall be adhered to, as determined by the Engineer and OAR.
- B. Testing Records:
1. Provide a record of each piping installation during the testing. These records shall include:
 - a) Date of test.
 - b) Identification of pipeline tested or retested.
 - c) Identification of pipeline material.
 - d) Identification of pipe specification.
 - e) Test fluid.
 - f) Test pressure.
 - g) Remarks: Leaks identified (type and location), types of repairs, or corrections made.
 - h) Certification by Contractor that the leakage rate measured conforms to the Specifications.
 - i) Signature of Owner's representative witnessing pipe test.
 2. Submit five (5) copies of the test records to the Engineer's representative upon completion of the testing.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Testing fluid shall be water for all hydrostatic tests.
- B. Provide pressure gauges, pipes, bulkheads, pumps, and meters to perform the hydrostatic testing.

PART 3 - EXECUTION

3.1 TESTING PREPARATION

- A. Pipes shall be in place and anchored before commencing pressure testing.
- B. Conduct hydrostatic tests on exposed and above ground piping after the piping has been installed and attached to the pipe supports, hangers, anchors, expansion joints, valves, and meters.
- C. Before conducting hydrostatic tests, flush pipes with water to remove dirt and debris.
- D. Test new pipelines which are to be connected to existing pipelines by isolating the new line from the existing line by means of pipe caps, plugs, special flanges, or blind flanges. After the new line has been successfully tested, remove caps, plugs, or flanges and connect to the existing piping.
- E. Conduct hydrostatic tests on buried pipe after the trench has been completely backfilled. The pipe may be partially backfilled and the joints left exposed for inspection for an initial leakage test. Perform the final test, however, after completely backfilling and compacting the trench.
- F. Pressure Test:
 - 1. All tests shall be made in the presence of and to the satisfaction of the Owner, Engineer, and any local or State inspector having jurisdiction.
 - a. Provide not less than three (3) days notice to the OAR, Engineer, and the authority having jurisdiction when it is proposed to make the tests.
 - b. Any piping or equipment that has been left unprotected and subject to mechanical or other injury shall be retested as directed by the OAR.
 - c. The piping systems may be tested in sections as the work progresses, but no joint or portion of the system shall be left untested.
 - 2. All elements within the system that may be damaged by the testing operation shall be removed or otherwise protected during the operation.
 - 3. Repair all damage done to existing or adjacent work or materials due to performance of the tests.

3.2 HYDROSTATIC TESTING

- A. Hydrostatic Testing of Aboveground or Exposed Piping: Open vents at high points of the piping system to purge air while the pipe is being filled. Subject the piping system to the test pressure indicated. Maintain the test pressure for a minimum of four (4) hours. Examine joints, fittings, valves, and connections for leaks. The piping system shall show no leakage or weeping. Correct leaks and retest until no leakage is obtained.

- B. Hydrostatic Testing of Buried Piping:
 - 1. Where any section of the piping contains concrete thrust blocks or encasement, do not start the pressure test until at least 10 days after the concrete has been poured. When testing mortar-lined piping, fill the pipe to be tested with water and allow it to soak for at least 48 hours to absorb water before conducting the pressure test.

 - 2. Apply and maintain the test pressure by means of a hydraulic force pump. Maintain the test pressure per the requirement of the authority having jurisdiction. No leakage is allowed.

 - 3. Repair and retest any pipes showing leakage.

- C. Test pressures for various pipe applications shall be per the requirements of the authority having jurisdiction. All fire mains shall meet NFPA 24 criteria.

3.3 PNEUMATIC TESTING

- A. Gravity Sewers: Lines labeled "SS" on the Drawings. Refer to Section 33 05 05: Low Pressure Air Testing Of Installed Sewer Pipe

- B. Drains: Lines labeled "DR" on the Drawings.
 - 1. The Contractor shall perform low pressure air testing in conformance with the requirements of UNI-B-6 "Recommend Practice for Low-Pressure Air Testing of Installed Sewer Pipe", as published by Uni-Bell Plastic Pipe Association. The test period shall be two (2) hours. The Engineer shall be present during all testing.

 - 2. During drain construction, all service laterals, stubs, and fittings shall be properly capped or plugged so as not to allow air loss. Where necessary, the Contractor shall restrain and seal caps, plugs, or short pipe lengths such that failure and leaks are prevented.

 - 3. Should a line section fail to meet test requirements, the Contractor shall determine the source, or sources of leakage, and make all necessary repairs as approved by the Engineer and OAR, and repeat the test until leakage is within specified limits.

END OF SECTION

SECTION 33 05 05.41 – LOW PRESSURE AIR TESTING OF INSTALLED SEWER PIPE

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope of Work: Furnish all labor, materials, equipment, and incidentals required to test all gravity sewer piping, fittings, and appurtenances as shown on the Drawings and specified herein.

1.2 FIELD TESTING

- A. General: At least ten (10) days prior to beginning testing, the Contractor shall submit a testing plan to the Engineer for review.
- B. Gravity Piping:
 - 1. The Contractor shall perform low pressure air test on all gravity piping.
 - 2. Standard: UNI-B-6-98, "Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe", as published by UNI-Bell Plastic Pipe Association.
 - 3. Test Section: Between adjacent manholes, not to exceed 400 feet.
 - 4. Test Pressure: 4.0 psig greater than the average back pressure of any groundwater above the pipe invert, but not greater than 9.0 psig.
 - 5. Preparation:
 - a. Before testing, the Contractor shall determine groundwater level and adjust the test pressure accordingly.
 - b. Before testing, the Contractor shall flush all gravity lines to obtain free flow through each line.
 - 6. Low Pressure Test Procedure:
 - a. Low pressure air shall be slowly introduced into the sealed line until the internal air pressure reaches the specified test pressure.
 - b. When temperatures have been equalized and pressure stabilized at the specified test pressure, the air supply shall be shut off.

- c. If the time shown in the Table 15064-1 elapses before the air pressure drops 1.0 psig, the section undergoing the test shall have passed.
 - d. Should the section fail to meet test requirements, the Contractor shall determine the sources of leakage, make necessary repairs and repeat the test until the test section passes.
7. Closed Circuit Television Inspection:
- a. Internal video inspection for the gravity sewer shall be performed by the Contractor to check for alignment and deflection. The television inspection shall also be used to check for cracked, broken, or otherwise defective pipe, and overall pipe integrity.
 - b. The video internal inspection will be performed in two stages. The first inspection will be within 30 days after the installation of the gravity sewer pipe, provided the road base is in place and the manhole rings and covers are to grade. The requirement of road base being in place shall be waived if the top of the sewer is 12 feet below the finished grade. In such cases, the video inspection shall be performed once the trench has been compacted up to the road base. The second inspection of the gravity sewer pipe will be before the end of the one-year warranty period.
 - c. If the first or second video inspection reveals cracked, broken, or defective pipe, or pipe misalignment resulting in vertical sags in excess of 1-1/2" and in the case of PVC pipe a ring deflection in excess of 5%, the Contractor shall be required to repair or replace the pipeline. Successful passage of both the low pressure air exfiltration test and video inspection is required before acceptance by the Owner.
 - d. Prior to repair or replacement of failed sewer pipe, the method of repair or replacement shall be submitted to the Engineer for approval. Pressure grouting of pipe or manholes shall not be considered as an acceptable method of repair.
 - e. Additional requirements detailed in Specification 02762: Televising Sanitary Sewer Systems.

Table 15064-1
MINIMUM SPECIFIED TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP FOR SIZE AND
LENGTH OF PIPE INDICATED FOR Q = 0.0015

1 Pipe Diameter (in).	2 Minimum Time (min:sec)	3 Length for Minimum Time (ft)	4 Time for Longer Length (sec)	Specification Time for Length (L) Shown (min:sec)								
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft	
4	3:4	59	.380 L	3:4	3:4	3:4	3:4	3:4	3:4	3:4	3:4	3:4
6	5:4	39	.854 L	5:4	5:4	5:4	5:4	5:4	5:4	5:4	5:4	6:2
8	7:3	29	1.520 L	7:3	7:3	7:3	7:3	7:3	8:5	10:08	11:24	
1	9:2	23	2.374 L	9:2	9:2	9:2	9:5	11:42	13:51	15:49	17:48	
1	11:20	19	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38	
1	14:10	15	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04	
1	17:00	13	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41	
2	19:50	11	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31	
2	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33	
2	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48	
3	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15	
3	31:10	72	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53	
3	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46	
4	39:48	57	41.883 L	69:48	104:42	139:37	174:30	209:24	244:19	279:13	314:07	
4	45:34	50	54.705 L	91:10	136:45	182:21	227:55	273:31	319:06	364:42	410:17	
5	51:02	44	69.236 L	115:24	173:05	230:47	288:29	346:11	403:53	461:34	519:16	
6	56:40	4	85.476 L	142:28	213:41	284:55	356:09	427:23	498:37	569:50	641:04	

Note: If there has been no leakage (zero psig drop) after one hour of testing, the test section shall be accepted and the test complete (See Section 7.5).

End of Section

[THIS PAGE INTENTIONALLY LEFT BLANK]

SECTION 33 05 19
PRESSURE PIPING TIED JOINT RESTRAINT SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This section describes the requirements and procedures for pressure piping tied joint systems.

1.3 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI):
 - 1. ANSI B1.1 - Unified Inch Screw Threads.
- B. ASTM International (ASTM):
 - 1. ASTM A36 - Standard Specification for Carbon Structural Steel.
 - 2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 3. ASTM A143 - Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
 - 4. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 5. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - 6. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 - 7. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
 - 8. ASTM A588 - Specification for High Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 in. (100 mm) Thick.
 - 9. ASTM B633 - Specification for Electrodeposited Coating of Zinc on Iron and Steel.
 - 10. ASTM F436 - Specification for Hardened Steel Washers.

1.4 SUBMITTALS

- A. Shop Drawings: Indicate restrained joint details and materials being utilized. Submit layout drawings showing piece numbers and locations. Also, indicate restrained joint locations.
- B. Product Data: Submit catalog data for restrained joint details and installation instructions.
- C. Design Data: Submit design calculations showing determination of restrained lengths and submit joint restraint details. Use joint restraint devices specifically designed for applications described in manufacturer's data.

- D. Manufacturer's Installation Instructions: Submit installation instructions.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- F. Project Record Documents: Record actual locations of joint restraints.

PART 2 - PRODUCTS

2.1 PIPE RESTRAINT

- A. All plugs, caps, tees and bends, unless otherwise specified, shall be restrained by mechanically restrained joints. Fittings shall be restrained with Meg-A-Lug or equal pipe restraint with collars, tie rods and retainer glands shall be only if specifically approved by the Wastewater Division. Where concrete is to be placed around bolted joints, a sheet of 3 mil (minimum) polyethylene shall be placed between the fitting and the concrete. Tie rods, clamps or other metal components shall be stainless steel 316. Backfilling over pipe restraints shall not proceed until inspected by the designated inspector.
- B. Manufacturers
 1. ROMAC Industries "GripRing"
 2. EBAA Iron "MEGALUG"
 3. Or approved substitution.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify pipe and fittings are ready to receive work.
- B. Field measure and verify conditions.
- C. Clean surfaces of pipe and fittings to receive tied joint restraint system.

3.2 INSTALLATION

- A. Install joint restraint system in strict accordance with manufacturer's instructions, requirements, and recommendations. Ensure that joints are mechanically locked together to prevent joint separation.

END OF SECTION 33 05 19

SECTION 33 11 00
WATER UTILITY DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. The work covered by this Section consists in furnishing all labor, equipment and materials, and in performing all operations in connection with construction of water utility distribution piping and appurtenances, complete and ready for use in accordance with the latest Specifications of the American Water Works Association and the applicable plans, and subject to the terms and conditions of the contract.

1.3 MAINTAINING WATER SERVICE AND SHUTDOWNS

- A. The Contractor's attention is called to the fact that the existing system must be kept in operation at all times.
- B. No valve or other control device on the existing system shall be operated by the Contractor without first obtaining approval from the existing system's owner.

1.4 REFERENCES

- A. Orlando Utilities Commission (OUC) Water Business Unit Construction Standards, General Policy and Procedures (latest revision).
- B. OUC Water Material Specifications Manual (latest revision).
- C. Nation Fire Protection Association (NFPA) Codes and Standards (latest revision).

1.5 SUBMITTALS

- A. Shop Drawings: Indicate piping layout, including piping specialties.
- B. Product Data: Submit data on pipe materials, pipe fittings, valves, hydrants, and accessories.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- D. Project Record Documents: Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations.

- E. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.6 QUALITY ASSURANCE

- A. Perform work in accordance with FDOT Standard Specifications except as modified herein.
- B. Perform work in accordance with OUC standards.
- C. Perform work in accordance with NFPA 24, Standard for the Installation of Private Fire Service Mains
- D. Maintain one copy of each document on site.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Materials and construction pertaining to construction of water distribution systems shall be in accordance with American Water Works Association (AWWA) Standards.
- B. Materials and construction pertaining to construction of fire services and mains shall be in accordance with the National Fire Protection Association (NFPA) standards.
- C. All piping materials and appurtenances installed, as a part of the Orlando Utilities Commission water distribution system shall be in accordance with the OUC Water Materials Specifications Manual and the latest revisions thereto. Such materials shall, in no event, be less than that necessary to conform to the requirements of any applicable law, ordinances, or codes.
- D. All piping materials and appurtenances shall be new, unused, and designed for the use intended. The materials shall be of standard first grade quality, produced by expert workers, and intended for the use for which they are offered. Materials, which are inferior or are lower in grade than indicated, specified, or required shall not be accepted. The Owner, Engineer of Record, and/or Orlando Utilities Commission reserve the right to make such judgments.
- E. All pipe diameter of 12" and less shall have a minimum burial depth of 36" and not to exceed 48" deep unless approved by the Owner, Engineer of Record, and/or OUC.
- F. All pipe with a diameter of 12" or greater shall have a minimum burial depth of 48" and not to exceed 60" depth unless approved by the Owner, Engineer of Record, and/or OUC.
- G. Materials and construction pertaining to restoration and construction of roads and structures shall be in accordance with the latest edition of FDOT Standard Specifications for Road and Bridge Construction or as called for on the Plans.

- H. No glued joints shall be allowed. Mechanical restrainers are the only acceptable method of restraint.
- I. All interior coatings and equipment in contact with potable water shall be approved per NSF 61.

2.2 DUCTILE IRON PIPE (DIP)

- A. All 4" through 24" ductile iron pipe used in the water distribution system shall be Pressure Class 350 compression/slip joint pipe conforming to ANSI/AWWA C150/A21.91 and ANSI/AWWA C151/A21.91 and the latest revisions thereto unless otherwise specified. All ductile iron pipes shall be lined with cement mortar in conformance with ANSI/AWWA C104/A21.90 and the latest revisions thereto. Self-restraining gaskets installed with ductile iron pipe shall be proprietary gaskets made by the same manufacturer as that of the pipe. Joints between pipe and fitting shall be mechanical joint.
- B. Acceptable manufacturers of DIP are currently shown in the OUC Water Material Specification Manual at www.ouc.com.

2.3 POLYVINYL CHLORIDE PIPE

- A. C900 PVC Pipe (4")

All 4" PVC pipe used in the water distribution system shall be SDR 18 compression joint PVC pipe conforming to AWWA C900 and the latest revisions thereto. The outside dimension (OD) shall be 4" cast iron O.D. with wall thickness DR 18. The color shall be Water Blue, or the pipe shall have continuous blue markings to conform to the AWWA adopted color code. Compression joint PVC shall have an elastometric-gasket bell on one end and connections shall be made using an gasket-gasket conforming to ASTM D3139. Coupling end pipe shall not be used. Fittings used with C900 PVC pipe shall be Class 350 ductile iron Compact fittings conforming to ANSI/AWWA C153/A21/53 and the latest revision thereto.

- B. Class 200 PVC Pipe (2" or smaller)

All 2" or smaller PVC pipe used in the OUC water distribution system shall be Class 200 compression joint pipe. The outside dimension (OD) shall be the same as 2" galvanized Schedule 40 pipe. The color shall be blue, or the pipe shall have continuous blue markings to conform to the AWWA adopted color code. Compression joint PVC shall have an gasket-gasket bell on one end and connections shall be made using and elastomeric-gasket conforming to ASTM D3139. Coupling end pipe shall not be used.

- C. Restrained Joint Pipe (PVC)

All approved sizes of C900/RJ must be Class 150 (DR18) rated.

- D. Acceptable manufacturers of PVC pipe are currently shown in the OUC Water Material Specifications Manual (latest revision).

2.4 HIGH DENSITY POLYETHYLENE (HDPE) PIPE

- A. HDPE shall have a ductile iron pipe outside diameters and be in accordance with AWWA C 906. The dimension ratio shall be verified by the Contractor based on the anticipated pullback force and external loads required for the directional drilling and at a minimum the pipe shall be DR11. The minimum working pressure rating of the pipe supplied shall be minimum 200 psi.
- B. Materials used for the manufacturing of polyethylene pipe shall be PE 4710 High Density Polyethylene (HDPE) meeting the ASTM D3350 cell classification of 345464E (for color stripes). The material shall have a minimum Hydrostatic Design Basis (HDB) of 1600 psi at 73°F when tested in accordance with Plastics Pipe Institute (PPI) TR-3 and shall be listed in the name of the pipe and fitting manufacturer in PPI TR-4.
- C. Pipes shall be marked in accordance with AWWA requirements.
- D. Contractor shall use HDPE MJ adaptors for making connection to different pipe material such as DIP or PVC. Mega-Lug restraints with stainless steel inserts will not be allowed for connection; however electro fusion couplings are acceptable.

2.5 PIPE IDENTIFICATION

- A. Ductile iron potable water mains require special identification. See OUC standard detail sheet.
- B. PVC water mains shall either be solid blue on color or white with blue lettering. Lettering shall appear on three sides of the pipe and shall run the entire length of the pipe. The lettering shall be a permanent part of the pipe.
- C. Three solid blue lines permanently manufactured into the piping material shall identify polyethylene water mains. The lines shall appear on three (3) sides of the pipe, run the entire length of the pipe, and be no less than 3/16" wide.
- D. All nonmetallic water mains shall be installed with a continuous, blue, insulated, 10 gauge or larger copper wire installed directly on top of the pipe for future location purposes. The wire shall be installed in such a fashion so as to sustain continuity. The contractor must perform a successful continuity test with an OUC representative present. Location markers, if used, shall be installed at no less than 40 foot intervals and at the manufacturer recommended depth.

2.6 FITTINGS

- A. Ductile iron pipe fittings, including bends, tees, crosses, reducers, sleeves, caps, plugs, and offsets, shall all be mechanical joint in conformance with ANSI/AWWA C111.A21.11 and the latest revision thereto. Ductile iron pipe fittings shall have standard bituminous pipe coating outside, and cement lining and seal coat inside in conformance with ANSI/AWWA C104/A21.40 or protective fusion bonded epoxy coating for interior and exterior conforming to C116/A21.16.98 and the latest revisions thereto.
- B. All four (4) inch through twelve (12) inch ductile iron fittings, except offsets, shall be Class 350 "compact" fittings conforming to ANSI/AWWA C153/A21.53 and the latest revisions thereto.

- C. All 16" through 24" ductile iron pipe fittings and six (6) inch through twelve (12) inch offsets shall be Class 350 "compact" fittings conforming to ANSI/AWWA C153/A21.53 and the latest revisions thereto. Thirty (30) inch ductile iron pipe fittings shall be Class 250 "Compact" fittings conforming to ANSI/AWWA C153/A21.53 and the latest revisions thereto.
- D. Acceptable manufacturers are listed on the OUC Water Material Specifications Manual (latest revision).

2.7 FITTINGS – SPECIAL CONSIDERATIONS

- A. Certain construction requirements necessitate the use of, or adaptation to, pipe, fittings, or joints not usually installed in the Orlando Utilities Commission water distribution system. All special pipe, fittings, or joints shall be designed for the use intended and whenever possible, meet the appropriate AWWA standard.

1. Flanged Fittings

All flanged fittings shall be gray iron or ductile iron conforming to ANSI/AWWA C153/A21.53, C110/A21.10 and the latest revisions thereto, and shall be flange by flange, Class 250, pressure rating 250 psi. All flanges shall be faced and drilled in accordance with ANSI B16.1 Class 125.

2. Sleeves

In addition to meeting specifications for mechanical joint pipe fittings, sleeves shall generally be the short pattern.

3. Reducers

All reducers shall be MJ x MJ.

4. Caps and Plugs

All ductile iron caps and plugs shall conform to the pipe fitting specifications and they shall be tapped two (2) inch FIPT with a two (2) inch brass plug inserted.

5. Couplings

Couplings (transition) designed to join pipe of differing materials and diameters shall be bolted, sleeve-type couplings for plain end pipe conforming to ANSI/AWWA C219 and the latest revisions thereto. All transition couplings shall be used only for the type and diameter of pipe for which they were designed.

2.8 GATE VALVES

- A. Distribution system gate valves, four (4) inch through sixteen (16) inch, shall be resilient seat or wedge gate valves conforming to AWWA C116/A21.16 and the latest revisions thereto. The valves shall have mechanical joint ends with a working pressure of 200 psi, operate in the vertical position, open left or counter clockwise with a non-rising stem and a two (2) inch square operating nut. The interior of the cast iron or ductile iron valve shall

be lined with a thermosetting epoxy protective coating. All internal ferrous surfaces shall have a 4 mil factory applied thermosetting epoxy coating.

- B. Acceptable manufacturers are listed on the OUC Water Material Specifications Manual (latest revision).

2.9 BUTTERFLY VALVES

- A. Distribution system butterfly valves, twelve (12) inch through 24", shall be Class 150B for buried installation with mechanical joint connections and they shall conform to ANSI/AWWA C116/A21.16 and the latest revisions thereto. The operator shall open left or counter clockwise with a two (2) inch square-operating nut. All internal ferrous surfaces shall have a 4 mil factory applied thermosetting epoxy coating.
- B. Acceptable manufacturers are listed on the OUC Water Material Specifications Manual (latest revision).

2.10 TAPPING VALVES

- A. Four (4) inch through sixteen (16) inch tapping valves shall be Class 250 resilient seat or wedge valves conforming to AWWA C116/A21.16 and the latest revisions thereto. The valves shall have a mechanical joint end and a tapping valve end. They must operate in the vertical position, open left or counter clockwise with a non-rising stem and a two (2) inch square operating nut. The exterior and interior of the cast iron valve shall be lined with a thermosetting epoxy protective coating. All internal ferrous surfaces shall have a 4-mil factory applied thermosetting epoxy coating.
- B. Acceptable manufacturers are listed on the OUC Water Material Specifications Manual (latest revision).

2.11 FIRE HYDRANTS

- A. Materials for fire hydrant shall be as required by the OUC and/or the Authority Having Jurisdiction (AHJ).

2.12 SERVICE CONNECTIONS

- A. Materials for service connections shall be as required by the OUC.

2.13 BACKFLOW PREVENTION DEVICES

- A. Reduced Pressure Principle Backflow Preventer (RPZ)

RPZ devices shall be approved by OUC or meet ANSI/AWWA C511 and the latest revisions thereto or ASSE Standard #1013 (rev. 1993 or newest revision) or USC CCC&HR or Florida Building Code. Acceptable devices include, but not limited to, the table below.

<u>MAKE</u>	<u>SIZES</u>	<u>REQUIREMENT MET</u>
AMES	¾ thru 10"	ASSE
HERSEY	¾ thru 10"	USE

CLAVAL	¾ thru 1¼", 2" thru 10"	USC
FEBCO	¾ thru 10"	USC
BUCKNER	¾ thru 2"	ASSE
CONBRACO	¾ thru 2"	ASSE
NEPTUNE	¾ thru 3"	USC
RAINBIRD	¾ thru 10"	USC
WATTS	¾ thru 10"	USC
WILKINS	¾ thru 10"	USC, ASSE

PART 3 - EXECUTION

3.1 HANDLING

- A. All pipe, fittings, and appurtenances shall be handled in such a manner during transport, loading, unloading, and installation so as to protect the materials from any damage. Particular care shall be taken not to injure pipe coating, both interior and exterior. Broken, cracked, misshapen, imperfectly coated, or otherwise damaged or unsatisfactory material shall not be installed.
- B. When not being handled, the pipe shall be supported on timber cradles to provide uniform support along the full length of the pipe. The pipe shall be supported in a manner, which shall not permit distortion or damage to the lining or coating when being transported.
- C. Under no circumstances shall valves be dropped, skidded, rolled, or placed against pipe or other fittings in such a manner that damage could result. Slings, tongs, or hooks used for lifting shall be properly padded in such a manner as to prevent damage. Particular care shall be taken not to injure valve coatings, both interior and exterior. If any part of the valve's coating and lining is damaged, the valve replacement shall be made before installation.
- D. Valves shall be stored at all times in a safe manner to prevent damage and kept free of dirt, mud, or other foreign matter.
- E. Gaskets shall be stored in a clean, dark, dry location and out of contact with petroleum products until immediately before use. All gaskets shall be used on a first-in, first-out basis.
- F. Dirt or other foreign material shall be prevented from entering the pipe or pipe joint during handling or laying operations. When pipe laying is not in progress, the open ends of the pipe shall be closed by a watertight plug or some other acceptable means to ensure absolute cleanliness inside the pipe.

3.2 PLACEMENT AND BEDDING – DUCTILE IRON PIPE

- A. Ductile Iron pipe shall be installed in accordance with the manufacturer's specifications and instructions for the type of pipe use and the applicable manuals and AWWA Standards (the DIPRA *Handbook of Ductile Iron Pipe* and AWWA C600 for ductile iron pipe), unless otherwise stated in these standards.
- B. Proper tools, implements, equipment, and facilities shall be used for the safe installation of all materials. Pipe, fittings, valves, and other appurtenances shall be carefully lowered into the trench piece by piece. Under no circumstances shall piping materials be dropped, dumped, or slid into the trench.
- C. Lumps, blisters, and excess coating shall be removed from the bell and spigot ends of each pipe. The outside of the spigot and the inside of the bell shall be wire brushed and wiped clean, dry and free from oil and grease before the pipe is laid. Pipe joints shall be made up in accordance with the manufacturer's recommendations. Every effort shall be employed to ensure that sand or other debris does not enter the pipe.
- D. The interior of the pipe shall be thoroughly cleaned of all debris, tools, clothing, and other foreign matter, before being gently lowered into the trench and shall be kept clean during laying operations by means of plugs or other approved methods. Any residue considered difficult to remove by scouring flush shall be removed by appropriate means and swabbed or sprayed with a liquid sodium hypochlorite solution (NaOCl), hereafter called 10% liquid chlorine.
- E. When new main extensions are connected to existing mains, the new valve and/or fitting to be connected to the existing main shall be cleaned and shall receive a generous coating of 10% liquid chlorine. Any lateral dead end stubs (for future fire hydrants or water main extensions) shall be swabbed or sprayed with 10% liquid chlorine if they are not equipped with valves for adequate flushing and disinfection. The inside of tapping tees and the outside of the main to be sleeved shall be cleaned and swabbed or sprayed with 10% liquid chlorine to kill any trapped bacteria.
- F. Bell sections and spigot ends are to be cleaned of all foreign matter with a firm bristle brush. The lubricant used on the sealing gaskets shall be suitable for use in potable water and shall not support any bacteria growth. The lubricant shall be in closed container and kept clean at all times.
- G. Before laying any pipe, an adequate survey shall be accomplished to show horizontal and vertical alignment, and to prevent conflicts with other utilities.
- H. When laying pipe, the trench water shall be pumped out and kept at a minimum. During suspension of work for any reason for any time, including the end of the workday, a watertight plug shall be placed in the end of the pipe last laid to prevent mud or other foreign material from entering the pipe.
- I. Pipe shall be laid with bell ends facing in the direction of laying (upstream). The work shall at all times progress with caution so as to prevent damages to underground obstruction, both known and unknown. Every effort shall be made to lay the pipe in a straight line, using only the fittings designated on the plans.

- J. The cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or cement lining and so as to leave a smooth end at right angles to the axis of the pipe.
- K. Push-on joint pipe shall generally be used in the distribution system. All compact fittings shall be mechanical joint. The joints of all pipelines and fittings shall be made absolutely tight. The gasket material for the joint shall be properly positioned before the pipe is lowered into the trench. The joining of all pipe and fittings shall proceed in accordance with the manufacturer's instructions and requirements. Once the joint has been seated and tightened, all bolts and nuts shall be checked and retightened one more time.
- L. The push-on joint shall be made up by exerting sufficient force on the entering pipe so that its plain end is moved past the gasket until it seats completely as per the manufacturer's recommendations. Backhoe buckets or excavation equipment are not to be applied directly to the pipe.
- M. Plugs shall be inserted in the bells of all dead ends of the pipe, tees, and crosses, and plain ends shall be capped.

3.3 BACKFILLING AND COMPACTION – DUCTILE IRON PIPE

- A. After the pipe and fittings have been laid, inspected, and found to be satisfactory, the trench shall be backfilled in accordance with DIPRA Laying Condition 2.
- B. Backfill material shall be free from cinders, ashes, refuse, organic matter, boulders, rocks, stones, or other material that is unsuitable. The spoils of the trench may be used if it is suitable. All trenches shall be backfilled by hand, from the bottom of the trench to the centerline of the pipe in layers of 6 inches. Backfill material shall be deposited in the trench for the full width on each side of the pipe.
- C. Compaction shall be performed by tamping. The pipe shall be backfilled by hand or by approved mechanical methods from the centerline of the pipe to the specified grade. Compaction shall be done in accordance with the requirements of the agency having jurisdiction.
- D. In the absence of specific standards, all compaction shall conform to the following: The space between the pipe and the trench sides shall be packed full by hand shoveled earth, free from lumps, carefully deposited in layers, not exceeding 6 inches in depth. Such material shall be placed equally on each side of the pipe, and at the same time suitably tamped until enough fill has been so placed and compacted to provide a minimum cover of twelve (12) inches above the pipe. All backfill placed to this elevation shall be compacted to a minimum density of 98% of the modified proctor density. From this point, the backfill shall be compacted in uniform layers not exceeding twelve (12) inches in depth to a minimum of 98% of the modified proctor density where it is to support paving, sidewalks, etc. All other backfill shall be compacted to 90% of the modified proctor density.

3.4 PLACEMENT AND BEDDING – POLYVINYL CHLORIDE PIPE

- A. Polyvinyl Chloride pipe shall be installed in accordance with the manufacturer's specifications and instructions for the type of pipe use and the applicable manuals and AWWA Standards, the Unibell Handbook of PVC Pipe Design and Construction, and AWWA

M23 PVC Pipe Design and Installation for PVC pipe unless otherwise stated in these standards.

- B. Although recommended installation procedures for PVC pipe do not vary substantially from procedures used with other pipe products, there are differences that are significantly more important.
- C. Trench width at the ground surface may vary depending on depth, type of soil, and position of surface structures. The minimum clear width of the trench, sheeted or unsheeted, measured at the springline of the pipe should be one foot greater than the outside diameter of the pipe. The maximum recommended clear width of the trench at the top or the pipe is equal to the pipe outside diameter plus two feet.
- D. When laying PVC pipe, the trench water shall be pumped out and kept at a minimum until the pipe has been installed and backfill has been placed to a sufficient height to prevent flotation of the pipe. The trench bottom shall be constructed to provide a firm, stable, and uniform support for the full length of the pipe. Bell holes shall be provided at each joint to permit proper assembly and pipe support. When an unsuitable subgrade condition is encountered that could provide inadequate pipe support, additional trench depth shall be excavated and refilled with suitable foundation material. Rock, boulders, and large stones shall be removed to provide a four (4) inch soil cushion on all sides of the pipe and accessories.
- E. As with ductile iron pipe, PVC pipe shall be laid with bell ends facing the direction of laying (upstream). The work shall at all times progress with caution so as to prevent damage to underground obstruction, both known and unknown. Every effort shall be made to lay the pipe in a straight line, using only the fittings designated on the plans.
- F. To prevent damage, proper implements, tools, and equipment shall be used for the placement of pipe in the trench. Under no circumstances shall the pipe or accessories be dropped in to the trench.
- G. All foreign matter or dirt shall be removed from the pipe interior. Pipe joints shall be assembled with care, in accordance with the manufacturer's recommendations. The outside of the spigot, the interior of the bell, and the gasket shall be cleaned using a rag, brush, or paper towel to remove any dirt or foreign material before the assembling. The gasket, pipe spigot bevel, gasket groove, and sealing surfaces shall be inspected for damage or deformation. Any residue considered difficult to remove by scouring flush shall be removed by appropriate means and swabbed or sprayed with a liquid sodium hypochlorite solution (NaOCl), hereafter called 10% liquid chlorine. Only lubricant as specified by the pipe manufacturer shall be applied to the joint and gasket. The lubricant shall be suitable for use in potable water and it shall not support any bacteria growth.
- H. Push-on joint PVC pipe with factory-installed gaskets shall generally be used in the distribution system. All fittings shall be mechanical joint. The joints of all pipelines and fittings shall be made absolutely tight. The joining of all pipe and fittings shall proceed in accordance with the manufacturer's instructions and requirements. Once the joint has been seated and tightened, all bolts and nuts shall be checked and retightened one more time.

- I. After the spigot is correctly aligned to the bell of the pipe, the spigot shall be inserted in the bell until it contacts the gasket uniformly. The pipe shall then be pushed in the bell either by hand or with the use of a bar and block to the manufacturer's reference mark that indicated the correct depth of spigot penetration into the pipe's gasket joint. If undue resistance to insertion of the pipe end is encountered, or if the reference mark does not position properly, the joint shall be disassembled and the gasket position and other joint components shall be checked. The assembly steps shall be repeated.
- J. A square cut is essential for proper assembly of field-cut pipe. The pipe shall be marked around its entire circumference to assure such a cut. The factory-finished beveled end shall be used as a guide for field beveling, either with a pipe beveling tool or a wood rasp that will cut the correct taper. Sharp edges on the leading edge of the bevel shall be rounded off with a pocketknife or a file.
- K. The weight of fire hydrants, valves, or Ductile Iron fittings shall not be carried by PVC pipe. When pipe laying is not in progress, open ends of installed pipe shall be closed to prevent entrance of trench water, dirt, foreign matter, or small animals into the line. 6" and larger pipe shall be carried by Ductile Iron pipe only.

3.5 BACKFILLING AND COMPACTION – POLYVINLYL CHLORIDE PIPE

- A. After the pipe and fittings have been laid, inspected, and found to be satisfactory, the trench shall be backfilled in accordance with the applicable manuals and AWWA Standards, the Unibell Handbook of PVC Pipe Design and Construction, and AWWA M23 PVC Pipe and Design and Installation for PVC pipe.
- B. PVC pipe shall be installed with proper bedding providing uniform longitudinal support under the pipe. Backfill material shall be worked under the sides of the pipe to provide satisfactory support. Initial backfill material shall be placed to a minimum depth of six (6) inches over the top of the pipe. All pipe embedment material shall be selected and placed carefully, avoiding stones greater than 1 ½" in diameter and debris. Sharp stones and crushed rock larger than ¾" which could cause significant scratching or abrasion of the pipe, and shall be excluded from the embedment material. Proper compaction procedures shall be exercised to provide soil densities as required.
- C. After placement and compaction of pipe embedment materials, the balance of the backfill materials may be machine placed. All backfill material shall be free from cinders, ashes, refuse, organic matter, boulders, rocks, stones, or other material that is unstable. Proper compaction procedures shall be exercised to provide required densities to meet the same density requirements stated for ductile iron pipe.

3.6 JOINT DEFLECTION – DUCTILE IRON PIPE

- A. Whenever it is necessary to deflect ductile iron pipe from a straight line, either in a vertical or horizontal plane without the use of fittings, the amount of deflection allowed shall not exceed that allowed under AWWA C600 and in accordance with the manufacturer's recommendations. No deflection shall be sought until the pipe has been properly homed or seated.

- B. For restrained joint ductile iron pipe the deflection shall not exceed 80 percent of the manufacturer recommended deflection. The maximum allowable deflection for unrestrained ductile iron pipe shall not exceed that shown in the tables below.

Ductile Iron Pipe Deflection – 18 Foot Joint						
Nominal Pipe Size (inches)	Mechanical Joint			Push On Type Joint		
	Deflection (inches)	Radius of Curve (feet)	Deflection Angle (degrees)	Deflection (inches)	Radius Curve (feet)	Deflection Angle (degrees)
6	27.0	145	7	19.0	205	5
8	20.0	195	5	19.0	205	5
10	20.0	195	5	19.0	205	5
12	20.0	195	5	19.0	205	5
16	13.5	285	3	11.0	340	3*

* Maximum deflection angle may be larger than shown. Consult manufacturer

Ductile Iron Pipe Deflection – 20 Foot Joint						
Nominal Pipe Size (inches)	Mechanical Joint			Push On Type Joint		
	Deflection (inches)	Radius of Curve (feet)	Deflection Angle (degrees)	Deflection (inches)	Radius Curve (feet)	Deflection Angle (degrees)
6	30.0	160	7	21.0	230	5
8	22.0	220	5	21.0	230	5
10	22.0	220	5	21.0	230	5
12	22.0	220	5	21.0	230	5
16	15.0	320	3	12.0	380	3*

* Maximum deflection angle may be larger than shown. Consult manufacturer

3.7 JOINT DEFLECTION – POLYVINYLE CHLORIDE PIPE

- A. Deflection and longitudinal bending of PVC pipe shall be strictly in accordance with AWWA M23 *PVC Pipe-Design and Installation* and the Unibell *Handbook of PVC Pipe Design and Construction*.
- B. For restrained joint ductile iron pipe the deflection shall not exceed 80 percent of the manufacturer recommended deflection.

3.8 TRENCHLESS PIPE INSTALLATION

- A. Trenchless pipe installation shall be per FDOT Specifications.

3.9 FITTING INSTALLATION

- A. All fittings and related materials shall be handled in such a manner during transport, loading, unloading, and installation so as to protect the materials from any damage. Par-

ticular care shall be taken not to injure fitting coatings, both interior and exterior. Broken, cracked, misshapen, imperfectly coated, or otherwise damaged or unsatisfactory material shall not be installed.

- B. Gaskets shall be stored in a clean, dark, dry location until immediately before use. Dirt or other foreign material shall be prevented from entering the fitting during handling or laying operations.
- C. Proper tools, implements, equipment, and facilities shall be used for the safe installation of all materials. Fittings and other appurtenances shall be carefully lowered into the trench piece by piece. Under no circumstances shall materials be dropped, dumped, or slid into the trench.
- D. Lumps, blisters, and excess coating shall be removed from the bells of each pipe. The inside of the bell shall be wire brushed and wiped clean, dry and free from oil and grease before the fitting is installed. Joints shall be made up in accordance with the manufacturer's recommendations.
- E. Every effort shall be employed to ensure that sand or other debris does not enter the fitting. Any residue considered difficult to remove by scouring flush shall be removed by appropriate means and swabbed or sprayed with a liquid sodium hypochlorite solution (NaOCl), hereafter called 10% liquid chlorine.
- F. The lubricant used on the sealing gaskets shall be suitable for use in potable water and shall not support any bacterial growth. The lubricant shall be in closed containers and kept clean at all times.
- G. All fittings shall be mechanical joint. The joints of all pipelines and fittings shall be made absolutely tight. The joining of all pipe and fittings shall proceed in accordance with the manufacturer's instructions and requirements. The mechanical joints shall be centered in the bells and shall be assembled in accordance with the most current edition of AWWA standards.
- H. The joints shall be tightened on opposite sides of the fittings in such a manner that the gland shall be brought up evenly to the joint. If effective sealing is not obtained, the joint shall be disassembled and reassembled after thorough cleaning. The bolts shall be tightened to the torque recommended by the manufacturer. If the joint is defective, the fitting shall be removed and replaced.
- I. The following table indicates the typical number and sizes of bolts and nuts necessary for each facing or bell of the various sizes of compact (C153) ductile iron fittings.

Compact Ductile Iron Fittings

Size	Number of Nuts & Bolts	Bolt Diameter	Bolt Length
4"	4	3/4"	3 1/2"

6"	6	$\frac{3}{4}$ "	3 $\frac{1}{2}$ "
8"	6	$\frac{3}{4}$ "	3 $\frac{1}{2}$ "
10"	8	$\frac{3}{4}$ "	3 $\frac{1}{2}$ "
12"	8	$\frac{3}{4}$ "	3 $\frac{1}{2}$ "
16"	12	$\frac{3}{4}$ "	4"

- J. Plugs shall be inserted into the bells of all tees and crosses, and plain ends shall be capped.

3.10 VALVE INSTALLATION

- A. Proper tools, implements, equipment, and facilities shall be used for the safe installation of all valves. Valves shall be carefully lowered into the trench piece by piece. Under no circumstances shall valves be dropped, dumped, or slid into the trench.
- B. Lumps, blisters, and excess coating shall be removed from the bells of each valve. The inside of the bell shall be wire brushed and wiped clean, dry and free from oil and grease before it is installed. Joints shall be made up in accordance with the manufacturer's recommendations.
- C. Every effort shall be employed to ensure that sand or other debris does not enter the valve. Any residue considered difficult to remove by scouring flush shall be removed by appropriate means and swabbed or strayed with a 10% liquid sodium hypochlorite solution (NaOCl), hereafter called 10% liquid chlorine.
- D. The lubricant used on the sealing gaskets shall be suitable for use in potable water and shall not support any bacterial growth. The lubricant shall be in closed containers and kept clean at all times.
- E. The joints of all pipelines and valves shall be made absolutely tight. The joining of all pipe and valves shall proceed in accordance with the manufacturer's instructions and requirements.
- F. The mechanical joints shall be centered in the bells and shall be assembled in accordance with the most current AWWA standards.
- G. If effective sealing is not obtained, the joint shall be disassembled and reassembled after thorough cleaning. The bolts shall be tightened to the specified torques with a torque wrench.
- H. If the joint is defective, the fitting shall be removed and replaced. Valves shall be installed so that the operating nut is plumb.
- I. Cast iron valve boxes, with cast iron tops and bottoms, shall be installed over the valve, firmly supported and maintained centered over the valve and plumb over the operating nut of the valve with the box cover flush with the surface of the finished pavement or at such other levels as may be directed. The valve and valve box shall be installed so as to allow a valve key to move easily through the valve box and completely open and close the valve.

- J. Blow-off valves shall be installed at the ends of all dead-end water mains when practical. The blow-off shall be installed in such a fashion so as to direct the discharge water where it can be disposed of safely and easily. Fire hydrants installed at or near the dead-end may be used as blow-offs. All blow-off valves shall be restrained in accordance with the Specifications.

3.11 FIRE HYDRANT INSTALLATION

- A. Fire hydrant installation shall be as required by the OUC and/or AHJ.

3.12 JOINT RESTRAINT

- A. Joint restraint shall be in accordance with Section 330519.

3.13 SERVICE INSTALLATION

- A. Service connection installation shall be as required by the OUC.

3.14 BACKFLOW PREVENTION DEVICE INSTALLATION

- A. Pipe lines shall be thoroughly flushed to remove foreign material and debris before installing the device.
- B. If not already provided with the assembly, shut off valves shall be installed at each end of the device for testing and servicing purposes
- C. The device shall be placed in the horizontal position unless otherwise specified by the manufacturer's instructions.
- D. The device shall always be installed in an accessible location to facilitate testing and servicing.
- E. The centerline of the device shall always be installed a minimum of 12 inches plus the nominal size of the device above ground or the maximum flood level, whichever is highest, in order to prevent any part of the device from becoming submerged. The relief valve shall never be plugged or solidly piped into a drainage ditch, sewer, or pump. The relief valve discharge pipe shall be terminated a minimum of 12 inches above ground or maximum flood level and located so that it is clearly visible and accessible.
- F. The device shall be adequately supported to prevent the assembly from sagging.

3.15 LEAKAGE TEST FOR DUCTILE IRON AND PVC PIPE

- A. Where newly laid pipe or valved section thereof has been laid and backfilled between the joints, it shall be subjected to a hydrostatic gauge pressure of 150 psi for a minimum of 2 hours. During the hydrostatic test, the water main shall also be checked for leakage, which, if detected, shall be stopped by an OUC approved method.
- B. All testing shall be in accordance with AWWA Standard C600 and the latest revision thereto and shall be conducted in the presence of OUC and the Engineer of Record.

- C. Each valved section of the pipe shall be slowly filled with water. The test pressure, based on the elevation of the lowest point of the water line or section under test, and corrected to the elevation of the test gauge, shall be applied by means of test pump connected to the pipe in a satisfactory manner.
- D. Before applying the specified test pressure, all air shall be expelled from the pipe. If fire hydrants, sample points, taps, or blow-offs are not available at high elevations taps at points of high elevation shall be made before the test is made. Plugs shall be inserted in place of the tops after the test has been completed.
- E. Any cracked or defective pipes, fittings, or fire hydrants discovered as a consequence of the pressure test shall be removed and replaced with new material and the test shall be repeated until satisfactory results are received.
- F. The leakage test shall be conducted at the above-mentioned pressure of 150 psi. Leakage is defined as the quantity of water, in gallons per 2-hour, to be supplied into the newly laid pipe or any valved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.
- G. No pipeline installation shall be approved when leakage is greater than that determined by the following formula:

$$L = (SDP^{1/2})/148,000$$

L = allowable, in gallons per hour

S = length of pipe tested, in inches

D = nominal diameter of pipe, in inches

P = average test pressure during leakage test, in pounds per square inch (gauge)

- H. Any installation of 300 feet or less shall not exceed zero water loss.

3.16 DISINFECTION OF POTABLE WATER PIPING SYSTEM

- A. Disinfection and flushing of the potable water piping system shall be in accordance with Section 33 13 00.

END OF SECTION 33 11 00

SECTION 33 13 00
DISINFECTION OF WATER UTILITY DISTRIBUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This section provides written description and direction of required practices in the process of disinfecting potable water main and appurtenances prior to their placement for service.
- B. Chlorination shall not take place until:
 - 1. The main is constructed in accordance with the Contract Documents as modified by the Engineer during construction and all construction permit requirements are met.
 - 2. All blow offs, injection and sample points are constructed and ready for use.
 - 3. The main has been thoroughly flushed with scouring velocities as needed.
 - 4. The main has been successfully pressure and leakage tested.
 - 5. Chlorine neutralization chemicals, and methods for application and disposal of chlorinated water, have been established by the Contractor. The Contractor shall dispose of the water without causing a nuisance, property damage and in compliance with the National Pollution Discharge Elimination System (NPDES) and all applicable jurisdictions.
- C. The basic disinfection procedure, per ANSI/AWWA C651, consists of:
 - 1. Preventing contaminating materials from entering the water main during storage, construction, or repair.
 - 2. Removing, by flushing or other means, those materials that may have entered the water main.
 - 3. Chlorinating any residual contamination that may remain, and flushing the chlorinated water from the main.
 - 4. Protecting the existing distribution system from contaminants due to hydrostatic pressure test and chlorination procedures.

5. Determining the bacteriological quality by laboratory test after chlorination.
 6. Final connections of the approved new water main to the existing distribution system.
- D. All materials in contact with potable water will be NSF 61 certified and all chemicals used in disinfection will be NSF 60 certified.

1.3 APPLICABILITY

- A. All new water mains shall be flushed and disinfected in accordance with ANSI/AWWA C651 (or current revision thereto) and bacteriological samples shall be collected and analyzed on two consecutive days.
- B. All newly disinfected water mains shall maintain, after samples have been collected, a minimum pressure of 20 psi until a Letter of Clearance has been obtained from the FDEP.

1.4 REFERENCES

- A. Orlando Utilities Commission (OUC) Water Business Unit Construction Standards, General Policy and Procedures (latest revision).
- B. OUC Water Material Specifications Manual (latest revision).

1.5 SUBMITTALS

- A. Product Data: Submit procedures, proposed chemicals, and treatment levels for review.
- B. Test Reports: Indicate results comparative to specified requirements.
- C. Certificate: Certify cleanliness of water distribution system meets or exceeds specified requirements.

1.6 QUALITY ASSURANCE

- A. Perform work in accordance with ANSI/AWWA C651; maintain one copy of document on site.

PART 2 - PRODUCTS

2.1 CHLORINATION CHEMICALS

- A. 10% Liquid Chlorine (per ANSI/AWWA C651)

2.2 DECHLORINATION CHEMICALS

- A. As listed in Appendix C of ANSI/AWWA C651

PART 3 - EXECUTION

3.1 PREVENTIVE AND CORRECTIVE MEASURES DURING CONSTRUCTION

- A. It should be noted that any connection of a new water main to the existing distribution system prior to receipt of satisfactory bacteriological samples might constitute a cross-section. Therefore, the new main must be isolated until bacteriological tests described in Section 7 of AWWA Standard C651 are satisfactorily completed. OUC maintains a procedure to protect the existing distribution system from backflow contamination during testing of a new water main.
 - 1. OUC relies on the feed valve to be in a closed position to protect the existing distribution system during testing phase. The feed valve is to be operated only for flushing and chlorination procedures. To help ensure protection, any operation of this valve must be authorized by O.U.C.
 - 2. OUC does not allow a customer service connection to the new water main until final clearance is received from the DEP. However, to maintain pressure and insure water quality, the feed valve is put in the open position when bacteriological testing has been determined to be satisfactory by a state approved laboratory.
- B. Precautions shall be taken to protect pipe, fittings, and valves against bacteria contamination. It is realized that pipe and appurtenances cannot always be kept clean when stored on a construction site prior to laying, or in a storage yard awaiting installation. Immediately prior to laying the pipe, sections are to be inspected for debris and all debris shall be removed.
- C. When new main extensions are to be connected to existing mains, the new valve and/or fitting to be connected to the existing line is to be cleaned and shall receive a generous swabbing of 10% liquid chlorine. This process is done because the point of injection of the disinfection solution is generally downstream from these fittings.
- D. Any lateral dead end stubs (for future fire hydrants and main extensions) must be swabbed or sprayed with 10% liquid chlorine if they are not equipped with valves for adequate flushing and chlorination operation. The inside of tapping tees and the outside of the main to be sleeved are to be cleaned and swabbed or sprayed with 10% liquid chlorine.
- E. Blow-offs, referred to as "orifice size" or "flush opening of pipe lines", are to be installed so that flushing water will not cause erosion of soil or sod or pollution to existing streams or lakes. The blow-off valve shall be a throttling valve large enough to permit an adequate flush as described below. Blow-offs will be installed size for size on the newly installed main up to 12". All newly installed mains larger than 12" shall have at least 12" blow-offs. Larger blow-offs may be needed to achieve the required flushing velocity. Blow-offs shall be left in place until the new water main is placed into service.

3.2 FLUSHING

- A. Proper flushing and scouring of the newly installed water mains removes air and debris. A clean system is essential to the pressure test and chlorination process. Flushing, however, is not a substitute for preventive measures taken before and during pipe laying.
- B. The duration of flushing will vary with the length of line and to some extent, with pipe size. The objective of the flushing is to "change the water" in the new water line a minimum of six (6) times at a velocity of 5 fps minimum flushing velocity in order to scour out all loose debris. The duration of the flushing in seconds can be determined by multiplying 6 (change of water) times the length of pipe in feet divided by 5 (desired velocity of the water).
- C. Before flushing begins, the new water line must be filled with no air pockets. When filling new water lines 16" and larger, they must be filled with a 3/4" tap and all sample points open to assure discharge of air. After filling, the flushing is to be controlled from the blow-off valve to prevent entrapping air. Sample points are to be flushed during the flushing process.
- D. The flushing period shall be continuous once it is started. In other words, two separate five-minute flushes will not constitute a ten-minute flush. The minimum length of flushing time is six minutes for any size or any length of pipe.

3.3 DISINFECTING AND SAMPLING

- A. The disinfecting agent (chlorine) shall be liquid sodium hypochlorite (NaOCl) referred to previously as 10% liquid chlorine.
- B. The 10% liquid chlorine is introduced into the new line through a tapped inlet and a portable chlorinator to a measured residual of 25 mg/L (250 ppm) minimum. Care should be taken to prevent the backup of chlorine solution in the old water main by:
 - 1. Closing the upstream valve, and disconnecting the chlorinator.
 - 2. Simultaneously closing the blow-off valve and stopping the portable chlorinator.
- C. Flow during chlorination is controlled from the downstream or blow-off end of the line.
- D. Sampling spigots are to be opened and flushed with the chlorine solution prior to placement on the sampling point. After installation of the sampling spigots, they are to be capped, bagged, or foil wrapped to prevent contamination by windblown debris and locked to prevent unauthorized handling. Warning tags in good condition are to be attached to each sample point.
- E. The disinfecting or chlorinating procedure is generally a five (5) day process that normally starts on a Monday.
 - 1. Monday: Chlorine is introduced into the main and left there overnight.
 - 2. Tuesday: The chlorine is completely flushed, filled with system water, and secured for 24 hrs.

3. Wednesday: Samples are taken from each sample point and delivered to the OUC laboratory for analysis.
 4. Thursday: Repeat Wednesday samples.
 5. Friday: If both samples pass the lab test, the main may be placed into full service after FDEP clearance.
- F. OUC uses the continuous feed method of chlorination. The continuous feed method consists of placing 10% liquid chlorine in the main during construction, completely filling the main to remove all air pockets, flushing the completed main to remove particulates, and filling the main with potable water. Chlorine gas may be used as an alternative only when accomplished by a certified contractor.
- G. Procedure for chlorinating the main.
1. At a point not more than 10ft (3m) downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate such that the water will have not less than 25mg/L (250ppm) free chlorine. To ensure that this concentration is provided, measure the chlorine concentration at regular intervals in accordance with the procedures described in the current edition of *Standard Methods for the Examination of Water and Wastewater* or AWWA Manual M12, or using appropriate chlorine test kits. The table, from AWWA C651, below gives the amount of chlorine required for each 100 ft (30.5m) of pipe of various diameters. Solutions of 10% liquid chlorine required may be prepared with sodium hypochlorite or calcium hypochlorite.

Pipe Diameter		10 percent Chlorine Solution	
In	(mm)	gal	(L)
4	(100)	0.016	(0.06)
6	(150)	0.036	(0.14)
8	(200)	0.065	(0.25)
10	(250)	0.102	(0.39)
12	(300)	0.144	(0.54)
16	(400)	0.260	(0.98)
20	(500)	0.400	(1.50)
24	(600)	0.580	(2.20)

2. The chlorinated water shall be retained in the main for at least 24 hours. At the end of this 24 hr period, the treated water in all portions of the main shall have a residual of not less than 10 mg/L free chlorine.
3. Direct feed chlorinators, which operate solely from gas pressure in the chlorine cylinder, shall be used for the application of liquid chlorine. The danger of using direct feed chlorinators is that water pressure in the main can exceed gas pressure in the chlorine cylinder. This allows a backflow of water into the cylinder, resulting in severe cylinder corrosion and escape of chlorine gas. Hypochlorite solutions may be applied to the water main with a gasoline or electrically powered chemical feed pump designed for feeding chlorine solutions. Feed lines shall be

of such material and strength as to safely withstand the corrosion caused by the concentrated chlorine solutions and the maximum pressures that may be created by the pumps. All connections shall be checked for tightness before the solution is applied to the main. The pump must have a screen filter through which the chlorine solution must pass before injection into the main.

3.4 FINAL FLUSHING

A. The final flushing consists of the following steps:

1. Clearing the main of heavily chlorinated water: After the applicable retention period, heavily chlorinated water should not remain in contact with pipe for longer than 24-hrs. In order to prevent damage to the pipe lining or corrosion damage to the pipe itself, the heavily chlorinated water shall be flushed from the main until chlorine measurements show that the concentration in the water leaving the main is no higher than that generally prevailing in the distribution system or is acceptable for domestic use.
2. Disposing of heavily chlorinated water must meet appropriate governing agency regulations and is the responsibility of the developer/contractor.

3.5 BACTERIOLOGICAL TESTS

- A. Standard Conditions. After final flushing and before the new water main is connected to the distribution system, two consecutive set of acceptable samples, taken at least 24 hr apart, will be collected from the new main. Sampling points should be spaced 500 feet (152m) apart on distribution mains with turns and bends. On straight run mains, the spacing can be increased to 1000 feet (305m) apart. In addition, samples will be collected from each end of the line and from each branch. The sample points should be left no lower than three (3) feet above the finished parkway grade and no higher than five (5) feet. All samples shall be tested for bacteriological quality in accordance with *Standard Methods for the Examination of Water and Wastewater*, and shall show the absence of coliform organisms.
- B. Sampling Procedure. Samples for bacteriological analysis shall be collected in sterile bottles treated with sodium thiosulfate as required by *Standard Methods for the Examination of Water and Wastewater*. No hose or fire hydrant shall be used in the collection of samples. A corporation cock will be installed in the main with a copper tube gooseneck assembly. After samples have been collected, the gooseneck assembly may be removed and retained for future use.

3.6 EMERGENCY OR MAINTENANCE CHLORINATION

- A. In the event a water main should rupture and repairs need to be made all repairs will be made by an OUC approved method.

END OF SECTION 33 13 00

SECTION 33 32 16 – PACKAGED WASTEWATER PUMPING STATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope of Work

1. Furnish all labor, materials, permits, notifications, equipment and incidentals required for the construction, installation, and field testing of the lift station. Construction of the lift station includes but is not limited to wet well, pumps, associated piping, valves, coating, fittings, cables, associated electrical equipment including transformer, and access hatch, unless specified in other specifications.
2. These Specifications are intended to give a general description of what is required, but do not cover all details which will vary in accordance with the requirements of the equipment as offered. It is, however, intended to cover the furnishing, the shop testing, the delivery and complete installation and field testing, of all materials, equipment and appurtenances for the complete pumping units as herein specified, whether specifically mentioned in these Specifications or not.
3. For all units there shall be furnished and installed all necessary and desirable accessory equipment and auxiliaries whether specifically mentioned in these Specifications or not, and as required for an installation incorporating the highest standard for this type of service including field testing of the entire installation and instructing the regular operating personnel in the care, operation and maintenance of all equipment.
4. In order to provide single source responsibility and compatibility between the various equipment items, control panels for pumps specified in this Section shall be furnished by the supplier of the pumping equipment.

1.2 ELECTRICAL PROVISIONS

A. Scope of Work:

1. Furnish all labor, materials, equipment and incidentals required for a complete electrical system associated with the proposed lift station.
2. The Contractor shall furnish and install the necessary cables, transformers, protective devices, conductors, exterior electrical system, etc., to serve motor loads, lighting loads and miscellaneous electrical loads as indicated on the Drawings and/or as specified hereinafter.

3. All materials necessary for the complete installation shall be furnished and installed by the CONTRACTOR to provide complete power, lighting, communication systems, instrumentation, wiring and control systems as indicated on the Drawings and/or as specified herein.
4. All planned power interruptions shall be at the OWNER's convenience. Each interruption shall have prior approval.
5. Contractor shall coordinate with the Orlando Utilities Commission (OUC) for connection and installation of electrical power.
6. Entire electrical control panel and cabinet must come manufactured as UL certified before installed.

1.3 GRINDER PUMP STATION

A. Scope of Work:

1. Furnish all labor, materials, equipment and incidentals required for the proposed complete grinder pump station.
2. All materials for the grinder pump station shall be per the approved manufacturer's specifications, and as indicated in the Drawings.
3. All materials necessary for the complete installation shall be furnished and installed by the CONTRACTOR to provide complete grinder pump lift station as indicated on the Drawings and/or as specified herein.
4. All planned power interruptions shall be at the OWNER's convenience. Each interruption shall have prior approval.

1.4 RELATED WORK

- A. Concrete: Division 3
- B. Section 08 31 00: Access Hatch Doors
- C. Painting: Division 9
- D. Pipe, Supports and Testing: Division 15
- E. Earthwork and Sodding: Division 2

1.5 QUALIFICATIONS

- A. The pumps covered by these Specifications are intended to be standard pumping units of proven ability as manufactured by a manufacturer having a

minimum of five (5) years experience in the production of such pumps. The pumps furnished shall be designed, constructed and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed. Pumps shall be manufactured in accordance with the Hydraulic Institute Standards.

- B. All equipment furnished under this Specification shall be new and unused, shall be the standard product of manufacturers having a successful record of manufacturing and servicing the equipment and systems specified herein for a minimum of five (5) years.
- C. The pumps shall be furnished complete with accessories required.

1.6 SUBMITTALS

- A. Copies of all materials required to establish compliance with the Specifications shall be submitted in accordance with the provisions of the bidding documents. Submittals shall include at least the following:
 - 1. Shop and erection drawings showing all important details of construction, dimensions and anchor bolt locations.
 - 2. Descriptive literature, bulletins, and/or catalogs of the equipment.
 - 3. Data on the characteristics and performance of each pump. Data shall include guaranteed performance curves, based on actual shop tests of similar units, which show that they meet the specified requirements for head, capacity, efficiency, NPSH, submergence and horsepower. Curves shall be submitted on 8-1/2-inch by 11-inch sheets, at as large a scale as is practical. Curves shall be plotted from no flow at shut off head to pump capacity at minimum specified TDH. Catalog sheets showing a family of curves will not be acceptable.
 - 4. The total weight of the equipment including the weight of the single largest item.
 - 5. A complete total bill of materials of all equipment.
 - 6. A list of the manufacturer's spare parts to be supplied in accordance with Paragraph 1.05.
 - 7. All submittal data required by the General Conditions.
 - 8. Complete motor data including:
 - Nameplate identification No-
 - load current
 - Full load current

Full load efficiency
Locked rotor current
High potential test data
Bearing inspection report

- B. In the event that it is impossible to conform with certain details of the Specifications due to different manufacturing techniques, describe completely all nonconforming aspects.

1.7 OPERATING INSTRUCTIONS

- A. Operating and maintenance manuals shall be furnished. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc., that are required to instruct operating and maintenance personnel unfamiliar with such equipment. The number and special requirements shall be as specified in the bidding documents.
- B. A factory representative of all major component manufacturers, who has complete knowledge of proper operation and maintenance, shall be provided for one (1) 8- hour day to instruct representatives of the Owner and the Engineer on proper operation and maintenance. If there are difficulties in operation of the equipment due to the manufacturer's design or fabrication, additional service shall be provided at no cost to the Owner.

1.8 TOOLS AND SPARE PARTS

- A. One (1) set of all special tools required for normal operation and maintenance shall be provided. All such tools shall be furnished in a suitable steel tool chest complete with lock and duplicate keys.
- B. Guaranteed Parts Stock Program: The pump supplier shall have a guaranteed parts stock program in the State of Florida.
- C. Required spare parts include all parts that normally require maintenance in the five (5) years after installation. Spare parts shall be properly bound and labeled for easy identification without opening the packaging and suitably protected for long-term storage. Spare parts shall be delivered to the Owner prior to pump station start-up.

1.9 PRODUCT HANDLING

- A. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.
- B. All equipment and parts must be properly protected against any damage during

a prolonged period at the site.

- C. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.
- D. Finished surfaces of all exposed pump openings shall be protected.
- E. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.
- F. After hydrostatic or other tests, all entrapped water shall be drained prior to shipment, and proper care shall be taken to protect parts from the entrance of water during shipment, storage and handling.
- G. Each box or package shall be properly marked to show its net weight in addition to its contents.

1.10 WARRANTY

- A. The pump manufacturer shall warrant the units being supplied against defects in workmanship and material for a period of five (5) years.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. The pumping units required under this Section shall be complete including pumps and motors with proper alignment and balancing of the individual units. All parts shall be so designed and proportioned as to have liberal strength, stability, and stiffness and to be especially adapted for the work to be done.
- B. Each discharge connection for each pump shall be rigidly and accurately anchored into position. All necessary anchor bolts, nuts, and washers shall be Type 316 stainless steel and shall be furnished by the pump manufacturer for installation by the Contractor.
- C. Stainless steel nameplates giving the name of the manufacturer, the rated capacity, head, speed, and all other pertinent data shall be attached to each pump and motor.

2.2 PUMPS

- A. The pumps shall be totally submersible non-clog semi-positive displacement grinder pumps with submersible motors designed to pump sewage. Pumps shall be installed inside of hydraulic structures. Pump station shall come as a complete unit that includes the grinder pump, check valve, HDPE tank, controls, and alarm panel.

- B. Performance Requirements: The pumps furnished shall meet the "Performance Requirements" set forth at the end of this Section in Table 11208-A. The brake horsepower required by each pump shall not exceed the nameplate horsepower of the pump drive motor over the entire pump-operating curve.

2.3 SHOP PAINTING

- A. Before exposure to weather and prior to shop painting, all surfaces shall be thoroughly cleaned, dry and free from all mill-scale, rust, grease, dirt and other foreign matter.
- B. All pumps and motors shall be shop coated, with manufacturer's standard coating.
- C. All nameplates shall be properly protected during painting.
- D. Gears, bearing surfaces, and other similar surfaces obviously not to be painted shall be given a heavy shop coat of grease or other suitable rust-resistant coating. This coating shall be maintained as necessary to prevent corrosion during periods of storage and erection and shall be satisfactory to the Engineer up to the time of the final acceptance test.

2.4 CONTROL PANELS

- A. Control panels for the pumps shall be furnished by the Contractor.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in strict accordance with the manufacturer's instructions and recommendations and in the locations shown on the Drawings. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the manufacturer's recommendations. Anchor bolts shall be set in accordance with the manufacturer's recommendations.
- B. The Contractor shall submit a certificate from the equipment manufacturer stating that the installation of the equipment is satisfactory, that the equipment is ready for operation, and that the operating personnel have been suitably instructed in the operation, lubrication and care of each unit.

3.2 INSPECTION AND TESTING

- A. General:

1. The Engineer shall have the right to inspect, test or witness tests of all materials or equipment to be furnished under these Specifications, prior to their shipment from the point of manufacture.
2. The Engineer shall be notified in writing prior to initial shipment, in ample time so that arrangements can be made for inspection by the Engineer.
3. The Engineer or his representative shall be furnished all facilities, including labor, and shall be allowed proper time for inspection and testing of material and equipment.
4. Materials and equipment shall be tested or inspected as required by the Engineer, and the cost of such work shall be included in the cost of the equipment. The Contractor shall anticipate that delays may result because of the necessity of inspection, testing and accepting materials and equipment before their use is approved.
5. The services of a factory representative shall be furnished for one (1) day and he shall have complete knowledge of proper operation and maintenance to inspect the final installation and supervise the test run of the equipment. With the permission of the Owner these services may be combined with those provided under Paragraph 1.05 of this Section.
6. Field tests shall not be conducted until such time as the entire installation is complete and ready for testing.
7. The Contractor shall coordinate with the City of Orlando to perform a lift station startup in accordance with the City of Orlando standards.

B. Pumps:

1. After all pumps have been completely installed, and working under the direction of the manufacturer, conduct in the presence of the Engineer, Owner, and OAR, such tests as are necessary to indicate that pumps conform to the Specifications. Field tests shall include all pumps included under this Section. Supply all electric power, water or wastewater, labor, equipment and incidentals required to complete the field tests.
2. If the pump performance does not meet the Specifications, corrective measures shall be taken or pumps shall be removed and replaced with pumps which satisfy the conditions specified. A 24-hour operating period of the pumps will be required before acceptance. During this 24-hour operating period, the Contractor shall supply all power necessary.

3.3 FIELD TESTING

- A. Upon completion of all the mechanical work, the Contractor shall conduct testing as specified herein to demonstrate that the equipment performs in accordance with all specifications.
- B. The Contractor shall perform initial testing of the equipment ensuring to himself that the tests listed in the Final Acceptance Test paragraph below can be satisfactorily completed.
- C. The Contractor shall give written notice, seven (7) days in advance, of the date of Final Acceptance Test to the Owner and Engineer. All tests shall be in conformance with other applicable Sections of these Specifications.
- D. The Final Acceptance Test shall demonstrate that all items of these Specifications have been met by the equipment as installed and shall include, but not be limited to, the following tests:
 - 1. That all units have been properly installed and are in correct alignment.
 - 2. That the units operate without overheating or overloading any parts and without objectional vibration.
 - 3. That there are no mechanical defects in any of the parts.
 - 4. That the pumps meet the specified hydraulic requirements.
 - 5. That the pumps shall be capable of pumping raw, unscreened sewage.
 - 6. That the pump sensors and controls perform satisfactorily as to sequence control, correct start and stop elevations, and proper alarm functions.
- E. In the event that the equipment does not meet the Final Acceptance Test, the Contractor shall, at his own expense, make such changes and adjustments in the equipment which he deems necessary and shall conduct further tests until full satisfaction is indicated by the Engineer and written certification is received thereof.

3.4 TRAINING

- A. After completion of the field certification and testing, a minimum of three (3) separated four (4) hour operator instruction and training sessions on equipment and system operation shall be provided. Contractor shall provide a proposed list of dates and times to hold the training sessions to the Owner at least (3) three weeks prior to the proposed dates, Owner must approve times prior to final scheduling the training. The training shall provide a complete overview of all equipment, testing, adjusting, operation, and maintenance procedures. The training shall take the form of classroom sessions at the

project site conducted by the manufacturer or local representatives who are knowledgeable and familiar with the project. Hands- on instruction and training will be conducted so that actual operation and maintenance of the equipment and systems can be performed by Owner upon completion of the training. Training shall be provided to the owner prior to final system start up. The training shall take the form of classroom and field instruction and shall cover:

1. Documentation in the final Operation and Maintenance Manuals.
2. Use the Operation and Maintenance Manuals or other guides.
3. Equipment and system startup and shutdown.
4. System operation procedures for all modes of operation.
5. Procedures for dealing with abnormal conditions and emergency situations for which there is a specified system response.
6. Any and all special tools, equipment training manuals used during the training shall be the property of the OWNER upon completion of the training.

3.5 PUMP PERFORMANCE SCHEDULE

- A. Pumps shall be furnished according to "Table 11208-A, Pump Performance Schedule" below:

TABLE 11208-A

PUMP PERFORMANCE SCHEDULE – LIFT STATION

Parameter	LS
Number of Pumps	1
Pump Type	Submersible
Pump Manufacturer	E/ONE
Pump Model Number	WH-101-92
Design Capacity per Pump, GPM	15
TDH, Ft.	7
Minimum Size Solids, In.	1.5
Minimum Discharge Size, In.	1.5
Horsepower Per Pump, HP	1
Maximum RPM	1725
Voltage	120
Phase	1
Frequency(Hz)	60

END OF SECTION

SECTION 33 32 33 – COLLECTION SYSTEM BYPASS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. The work covered by this Section consists of providing all temporary bypassing to perform all operations in connection with the flow of wastewater around pipe segment(s) or lift stations. The purpose of bypassing is to prevent wastewater overflows and provide continuous service to all wastewater customers. The Contractor shall maintain wastewater flow in the construction area in order to prevent backup and/or overflow and provide reliable wastewater service to the users of the wastewater system at all times.

PART 2- PRODUCTS

2.01 GENERAL

- A. The Contractor shall provide and maintain adequate equipment, piping, tankers and other necessary appurtenances in order to maintain continuous and reliable wastewater service in all wastewater lines as required for construction. Bypass pumping operations to be conducted by manned supervision 24 hours per day (including weekends) and backup emergency auto-dialer installed. The Contractor shall have tankers, backup pumps, backup generators, piping and appurtenances ready to deploy immediately.
- B. Bypass pumps shall be skid mounted diesel pumps/systems as manufactured by Thompson Pumps, Godwin Pumps, Rain for Rent, or an approved equal.
- C. Blocked gravity lines shall include two (2) line stops, one (1) primary and one (1) redundant.
- D. Bypass equipment shall include discharge flow meter and multiple pressure gauges.
- E. Bypass plan/systems shall have complete redundancy and shall include one (1) back- up pump equal to the primary.

PART 3- EXECUTION

3.1 GENERAL

- A. The Contractor shall have scheduled delivery of all materials, equipment and labor necessary to complete the repair, replacement or rehabilitation to the job site prior to

isolating the gravity main segment, manhole, or pump station. The Contractor

shall demonstrate that the pumping system is in good working order and is sufficiently sized to successfully handle flows by performing a test run for a period of 48 hours prior to beginning the work.

3.2 TRAFFIC CONSIDERATIONS

- A. The Contractor shall locate bypass pumping suction and discharge lines so as to not cause undue interference with the use of streets, private driveways, and alleys. This requirement may necessitate temporary trenching of piping at critical intersections. Ingress and egress to adjacent properties shall be maintained at all times. Ramps, steel plates or others methods shall be deployed by the Contractor to facilitate traffic over surface piping. High traffic commercial properties may require alternate methods.

3.3 BYPASS PLAN

- A. The Contractor shall submit a comprehensive written plan according to Section 01 33 23: Shop Drawings, Products and Samples, that describes the intended bypass for the maintenance of flows during construction. The Contractor shall also provide a sketch showing the location of bypass pumping equipment for each pump station or line segments around which flows are being bypassed. The plan shall include any proposed tankers, pumps, bypass piping, backup plan and equipment, work schedule, monitoring log for bypass pumping, monitoring plan of the bypass pumping operation and maintenance of traffic plan. The Contractor shall cease bypass operations and return flows to the new and/or existing sewer when directed by the Owner. All piping shall be designed to withstand at least twice the maximum system pressure or a minimum of 50 psi, whichever is greater. During bypassing, no wastewater shall be leaked, dumped, or spilled in or onto, any area outside of the existing wastewater system. When bypass operations are complete, all bypass piping shall be drained into the wastewater system prior to disassembly.

3.4 BYPASS OPERATION

- A. The Owner shall review and provide written comments to the bypass plan prior to implementation of the bypass. The Contractor shall plug off and pump down the sewer manhole or line segment in the immediate work area and shall maintain the wastewater system so that surcharging does not occur.
- B. The Owner shall accept the bypass plan prior to implementation of the bypass.
Contractor will plug off and pump down the sewer manhole or line segment in the immediate work area and will maintain the wastewater system so that surcharging does not occur. A successful 3-day test period shall be performed during Owner work days (no weekends). If the Contractor is unable to isolate the system prior to installation of the temporary bypass connection, then a wet tap will be required at the expense of the Contractor.
- C. Where work requires the line to be blocked beyond NORMAL WORKING HOURS and bypass pumping is being utilized, the Contractor shall be responsible for on-

site monitoring the bypass operation 24 hours per day, 7 days per week, by on-site personnel. Additionally, back-up emergency auto-dialer installation is required.

- D. During bypassing, no wastewater will be leaked, dumped, or spilled in or onto, any area outside of the existing wastewater system.
- E. The Contractor shall insure that no damage will be caused to private property as a result of bypass pumping operations. The Contractor shall complete the work as quickly as possible and satisfactorily pass all tests, inspections and repair all deficiencies prior to discontinuing bypassing operations and returning flow to the sewer manhole, line segment, or lift station.
- D. The Contractor shall immediately notify the Owner should a sanitary sewer overflow occur and the Contractor shall take the necessary action to clean up and disinfect the spillage to the satisfaction of the Owner and/or other governmental agency. If sewage is spilled onto public or private property, the Contractor shall wash down, clean up and disinfect the spillage to the satisfaction of the Owner and/or other governmental agency. When bypassing, complete redundancy is required. One back-up pump equal to the primary unit shall be required. Bypass pumps and motors shall have a maximum rating of 55 decibels at 20 feet for sound attenuation.
- F. Contractor shall provide secure temporary fencing around all bypass pumping equipment. The Owner shall be given keys to access the bypass equipment.

3.5 CONTRACTOR LIABILITY

- A. The Contractor shall be responsible for all required pumping, equipment, piping and appurtenances to accomplish the bypass and for any and all damage that results directly or indirectly from the bypass pumping equipment, piping and/or appurtenances. The Contractor shall also be liable for all Owner personnel and equipment costs, penalties and fines resulting from sanitary sewer overflows. In addition to the aforementioned costs to be paid by the Contractor, a fine of \$5,000 per overflow occurrence or sanitary sewer disruption shall be assessed. For each 24-hour period following overflow that the wastewater overflow/damage is not completely cleaned, disinfected, and returned to full operational capacity an addition \$5,000 fine will be assessed daily. It is the intent of these specifications to require the Contractor to establish adequate bypass pumping as required regardless of the flow condition.

END OF SECTION

SECTION 33 33 00
GRAVITY SEWERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. The work covered by this Section consists in furnishing all labor, equipment and materials, and in performing all operations in connection with construction of sanitary (gravity) sewers, including excavation, trenching, backfilling, testing and appurtenant work as required.

1.3 MATERIAL DEPTH LIMITATIONS

- A. Pipe materials used for gravity sewers shall be subject to the depth limitation indicated herein.

1.4 REFERENCES

- A. City of Orlando Engineering Standards Manual. Contractor to refer to the latest revision by the City of Orlando.
- B. City of Orlando Standard Detail Drawings. Contractor to refer to the latest revision by the City of Orlando.

1.5 SUBMITTALS

- A. Shop Drawings: Indicate piping layout, including invert elevations.
- B. Product Data: Submit data on pipe materials, pipe fittings, and accessories.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- C. D. Project Record Documents: Record actual locations of piping, connections, and invert elevations. As-built drawings shall follow requirements stated in Chapter 5 of the City of Orlando Engineering Standards Manual. Contractor to refer to the latest revision by the City of Orlando.
- E. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.6 QUALITY ASSURANCE

- A. Perform work in accordance with FDOT Standard Specifications except as modified herein.
- B. Perform work in accordance with City of Orlando standards.
- C. Maintain one copy of each document on site.

PART 2 - PRODUCTS

2.1 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

- A. PVC pipe and fittings shall conform to ASTM D3034, SDR 26, (for pipes 4"–15"), ASTM F679 SDR 26 (for pipe diameters 18"–48"), PERMA-LOC, SPIROLITE (ASTM F894) and HOBAS (ASTM D3262) may be approved for special purposes as appropriate. Joints shall be made with integrally formed bells and spigots with factory installed rubber sealing ring gaskets. Joints shall conform to ASTM D3212 with push-on type elastomeric compression gaskets. Field solvent weld joints shall not be acceptable. Thicker walled pipe is required for depth of cover over 10 feet. For over 15 feet of cover and when crossing water or stormwater pipe use ductile iron pipe. Invert depths over 15-feet require approval by the Water Reclamation Division Manager.

2.2 DUCTILE IRON PIPE (DIP) AND FITTINGS

- A. The pipe shall be lined ductile iron (DI) with a minimum pressure class of Class 350 (4-12 inch), 250 (14-20 inch), 200 (24-inch), and 150 (30-64-inch). Fittings may be ductile iron or cast iron unless otherwise noted.
- B. Pipe shall be ANSI A2 1.51 (AWWA C 151). Fittings shall be ANSI/AWWA C110. Mechanical and Push-on Joints shall conform to be ANSI A2 1.11 (AWWA C111). Flange Joints shall conform to ANSI A2 1.10 and A2 1.15 (AWWA C 110 and C115), Class 125 with 1/8-inch full faced rubber gaskets.
- C. Restrained Joints shall be ductile iron mechanical joint retainer glands manufactured by American Cast Iron Pipe Co. or an approved equal. Flexible Joints shall be boltless with 15 degrees joint deflection per applicable portions of ANSI A2 1-10 (AWWA C 110) as manufactured by "Flex-Lok" by American Cast Iron Pipe Co., or an approved equal. Bolts shall conform to ANSI B 18.21 and nuts shall conform to B 18.2.1. of low carbon steel per ASTM A307, Grade B.
- D. All DIP and fittings shall have a protective interior lining. The lining shall be a ceramic epoxy material such as SP2000 or Protecto 401. All linings shall be applied to a nominal thickness of 40 mils. Polyethylene encasement, where required, shall be per ANSI A2 1.5 (AWWA C 105). If polyethylene encasement is not required, the pipe exterior shall be bituminous coated. Bituminous coating shall conform to Koppers No. 300M, or an approved equal. Color coded green per Section 9.04 of the City of Orlando Engineering Standards Manual.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Trench excavating and backfill including sheeting and bracing, dewatering, bedding and foundation, and furnishing and disposal of materials shall be performed in such a manner as to promote the safe and expedient execution of the work.

3.2 PIPELINE TRENCHING

- A. Excavation of trenches shall not advance more than 50 feet ahead of completed pipe installation except as approved by the Owner or his designee.
- B. Excavation in close proximity to existing utilities shall be performed in a manner to prevent damage. Representatives of utilities shall be contacted for assistance in locating buried lines.
- C. All excavations may be made by open cut unless otherwise indicated on the Drawings. Sides of trenches shall be kept as nearly vertical as possible from the trench bottom to a level of one foot above the top of the pipe. Trench bottoms shall be excavated true to line and shall be not less than 18 inches wide or more than 24 inches wider than the outside diameter of the pipe so a clear space of 9 to 12 inches is provided on each side of the pipe. Minimum trench width for small diameter pipe shall be 24 inches. Grade of the trench bottom shall be consistent with the method of bedding specified herein.

3.3 SHEETING, SHORING, AND BRACING

- A. Furnish, install, and maintain sheeting, bracing, and shoring support required to keep excavations within the easement or right-of-way, to support the sides of the excavation, and to prevent any movement which may damage adjacent pavements or structures, damage or delay the work, or endanger life and health. Voids outside the supports shall be immediately filled and compacted. Sheeting, bracing, and shoring to be used shall be designed by a Florida Registered Professional Engineer. All trenching shall be performed in compliance with the OSHA Trench Safety Act.

3.4 DEWATERING AND DRAINAGE

- A. At all times during construction keep excavations free from standing water. Sumps, if required, shall be located outside of load bearing areas so the bearing surfaces will not be disturbed. The Contractor is responsible for all dewatering permits. Before discharge of produced ground water to any surface, waters of the State can occur from a non-contaminated site, analytical tests on samples of the proposed untreated discharge water shall be performed to determine if contamination exists. Minimum requirements as set forth by FDEP Document 62-621.300(2) "Generic Permit for the Discharge of Produced Groundwater from any Non-Contaminated Site Activity" must be followed and test results must be below FDEP screening values for discharge. All FDEP reporting and record retention requirements shall be adhered to. Water pumped from the excavation shall be discharged to prevent re-entry into the soil strata being dewatered. Water containing silt in suspension shall not be pumped into sewer lines or adjacent streams. The method of disposing of water pumped from the excavation shall be approved by the City of Orlando and/or FDEP, prior to actual disposal. The sanitary sewer system shall not be used to dispose of dewatering drainage unless approved by

the City of Orlando and/or FDEP. Following completion of dewatering activities, Contractor shall fill all wellpoint holes with flowable fill or pea gravel for the entire depth.

3.5 STABILIZATION

- A. If portions of the bottom of trenches or excavations consists of material unstable to such a degree that, in the opinion of the City of Orlando and/or Engineer, it cannot adequately support the pipe, the bottom shall be over-excavated and stabilized with 3/4" stone or smaller with a minimum of 6 inch thick base or approved coarse granular stabilization material. Depth of stabilization shall be as directed by the City of Orlando and/or Engineer.

3.6 BEDDING OF PIPING

- A. All buried piping shall be continuously bedded and covered, except where concrete or flowable fill encasement, concrete cradles or boring and jacking are indicated.
- B. Any part of the trench bottom that is excavated below the pipe grade shall be backfilled to grade with a minimum of 6 inches of granular material and compacted as specified in the table below. Bedding materials shall be limited to Class I or Class II materials.
- C. All cover materials shall be clean fill with no debris and carefully deposited to avoid damage to the pipe and shall be compacted as specified in the table below.

3.7 TRENCH BACKFILLING

- A. Backfill shall be granular material or suitable previously excavated pipe trench material approved for use by the Owner or his designee. The granular backfill shall be carefully deposited in uniform lifts as specified below and each lift shall be wetted adequately as needed to obtain the required compaction density with vibratory compactors.
- B. Unless otherwise indicated or approved by the Owner or his designee, fills shall be placed in the loose lift thickness indicated hereafter and compact to a dry density not less than the following percentage of maximum dry density, determined by the Modified Proctor Test, ASTM D1557 unless otherwise noted.

Backfill Requirements				
Type of Fill	Usage	Thickness	%	ASTM
Trenched Pipe Foundation, Bedding	Beneath piping	6"	95	D1557
Trenched Pipe Cover	Over and/or around piping	6"	95	D1557

Utilities Trench Backfill	"Influence area" beneath other piping or utility lines	8"	95	D1557
	"Influence area" beneath rigid paving and railroad tracks	6"	98	D1557
	"Influence area" beneath non-rigid paving	9"	98	D1557
	Adjacent to or under Structures	9"	98	D1557
	Cropland, plant site, lawns	12"	85	D1557
	Structural Fill	All locations under minor structures (manhole, etc.)	12"	95
Granular Fill	Below concrete slab bedding, foundations, rigid paving and excavated areas adjacent	8"	98	D1557
Granular Bedding	Beneath concrete slabs	12"	85	D1557
Structural Backfill	See Trench Backfill			
General Site Grading Not Covered	Fill in other locations	12"	85	D1557
	Topsoil placement	12"	85	D1557

*"Influence area" shall be considered the area within lines sloped downward at 45 from degrees from the outer edges of paving, foundations, and utility lines.

3.8 PIPE LAYING AND JOINTING

- A. Gravity sewers will be laid in the dry to the elevations and slopes shown on the Drawings. Laser equipment shall be used to provide proper line and grade. Surveying equipment will be used to set the laser. The laser equipment will have a slope indicator to facilitate checking by both the pipe laying foreman and the Owner's Engineer or inspector. The tolerance shall be within 10% of the design slope as long as the minimum slope criteria are met. Upon completion of the work, the lines will be cleaned, with all debris removed from the sewer at a downstream manhole and each section of pipe will be TV- inspected to indicate any pipe defects. Any pipe defects, bellies or other deformities will be taken up and re-laid to provide the correct line and grade. Special attention will be given to the requirement that the pipe be laid in a dry trench with properly compacted bedding and with properly compacted backfill. The pipe shall be laid with the spigot ends pointing in the direction of flow starting at the lowest point. Joint contact surfaces shall be cleaned immediately prior to jointing. Lubricants, primers or adhesives shall be used as recommended by the pipe manufacturer. The minimum allowable cover for gravity sewers shall be 3 feet from the top of the pipe to the finish grade. However, should this depth not be feasible, where grade depressions along the alignment are unavoidable, ductile iron pipe shall be provided within the limits of the

lesser cover. In no case shall the pipe cover be less than 18 inches, unless special design considerations have been approved by the City of Orlando. Pipes shall be installed to the alignment and grade as shown on the Drawings.

Minimum As-built Slopes vs. Diameter	
<u>Diameter</u>	<u>% Slope</u>
8"	0.28
10"	0.22
12"	0.18
15" or larger	0.12

3.9 TEE BRANCHES FOR SERVICE LATERALS

- A. Tee branches are to be installed in conjunction with the laying of sewer pipe. Tees to serve all existing and future laterals shall be installed. The longitudinal barrel of branch fittings shall conform to the line and grade, diameter and quality of the sewer main. All service laterals shall be perpendicular to the longitudinal axis of the pipe.

3.10 LATERALS

- A. All laterals shall be installed 90 degrees off the sewer main at minimum grade of 1 percent and located between 3 and 4 feet below the right-of-way/easement line finished grade with a two-way cleanout assembly between the sidewalk and curb line. A tee branch fitting for each service line shall be provided. Double or single wyes are not acceptable. All lateral ends not connected shall be plugged with a PVC plug at the right-of-way/easement line. All laterals shall be securely sealed to withstand the internal pressure of leakage or air pressure testing. The plug shall be capable of removal without injury to the socket. A cross (+) shall be saw cut in the top of the curb directly over the lateral location. If curbing is not part of the work, a 4" x 4" x 3' plastic stake shall be painted green and installed (at the end of the connection). Clean-out caps shall be PVC and of the inverted hex-nut type.

3.11 PROTECTION OF WATER SYSTEM CROSSINGS

- A. Where the horizontal separation between sanitary sewer and potable water lines are less than 10 feet, the sewer pipe shall be constructed of lined ductile iron pipe with high pressure joints. Where the sewer pipes cross any potable water lines with a vertical clearance of less than 18 inches, a minimum of 10 feet each side of the crossing shall be high pressure joint lined ductile iron pipe.

3.12 STORMWATER CROSSINGS

- A. Where sanitary sewer crosses under stormwater pipe with a vertical clearance of less than 12" or over with a vertical clearance of less than 6", a minimum of 10 feet each side fo the crossing shall be lined ductile iron pipe with high pressures joints. Nearest joint shall be 10 feet each side of crossing.

3.13 DOWNSTREAM PROTECTION

- A. Dirt and debris collected in the pipe during construction shall not be flushed downstream. The open end of pipe shall be closed daily to prevent foreign matter from entering.

3.14 CONNECTIONS

- A. Transition Connections

Where pipes of differing materials (PVC to DIP, etc.) are to be connected together between manholes, suitable transition couplings shall be "Eastern Standard Mission Couplings" manufactured by Mission, or an approved equal. Concrete collars are not acceptable and changes in pipe size or slope are not allowed between manholes.

- B. Connections to Manholes

Connections shall be in accordance with the Drawings. Connections shall be made with an approved flexible wall penetrating boot or fiberglass bell that is integral with the manhole base. All openings for pipes into existing structures shall be made by cutting with a power driven circular coring machine.

- C. Connections to Wet Wells

One joint (18-20 feet) of ductile iron pipe shall extend outward from the structure. Perform connections as for manholes.

- D. Conflicting Structures and Protection of Sanitary Sewer at Utility Crossings

Where it becomes necessary to extend sewers through structures, such as conflicting manholes, junction boxes, etc., the pipe shall be ductile iron within a casing pipe with no joints inside the conflicting structure or casing.

3.15 TESTING

- A. Testing and closed-circuit television inspection shall be in accordance with Section 330130.

- B. PVC Ring Deflection

Maximum diameter ring deflection shall not exceed five (5) percent of the internal pipe diameter throughout the warranty period when tested by a mandrel. The Mandrel shall be a GO-NO-GO type with an unequal number of runners, minimum of nine and a maximum distance between the runners of two inches. A gauging ring certified for each size of pipe inside diameter and the mandrel size shall be as follows:

Mandrel Sizing	
Pipe Size	Mandrel Diameter
8"	7.28
10"	9.08
12"	10.7

15"	13.2
-----	------

- C. Should 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, water, and all other items necessary to conduct the required testing and perform the necessary system repairs required to comply with the specified test. On pipes determined to have excessive deflection, the length in question shall be re-laid at no additional cost to the Owner.
- D. There shall be no detectable level of infiltration or exfiltration from pipeline and laterals at the time of inspection. Any evidence of leakage must be corrected prior to acceptance by the Owner.
- E. All tests shall be completed and accepted by the Owner prior to the placement of asphalt over sewer lines. Both private systems and those to be dedicated to the City shall be televised by City forces to determine if any defects are present in the system. Prior to requesting an inspection, the Contractor shall be responsible for removing all dirt and debris from the sewer system and installing a stabilized driving surface which allows access to all manholes. Inspection requests shall be made 48 hours in advance.
- F. A written punch list of all discovered defects shall be prepared. The Contractor shall repair all defects noted and successfully pass re-inspection prior to final acceptance by the Owner. All costs associated with re-inspection shall be borne by the Contractor.

END OF SECTION 333300

SECTION 33 34 00
PRESSURIZED PIPING SYSTEMS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish all labor, materials, equipment and incidentals required to install ductile iron pipe and restrained joint ductile iron pipe and cast iron or ductile iron restrained joint fittings, complete, as shown on the Drawings and specified in this Section.
- B. Fittings are noted on the drawings for the Contractor's convenience and do not relieve him from laying and jointing different or additional items where required.
- C. The Contractor shall furnish all labor, materials, equipment and incidentals required to install push-on joint or restrained joint ductile iron pipe, complete as shown on the Drawings and Specifications.
- D. Newly installed pipe shall be kept clean and free of all foreign matter. All DI pipe installed underground shall be poly wrapped unless noted otherwise on the plans.

1.02 REFERENCES

- A. American Water Works Association (AWWA) and American National Standards Institute (ANSI) latest edition:
 - 1. ANSI/AWWA C105/A21.5 - Polyethylene Encasement for Ductile Iron Pipe Systems
 - 2. ANSI/AWWA C111/A21.11 - Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings
 - 3. ANSI/AWWA C115/A21.15 - Flanged Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Fittings
 - 4. ANSI/AWWA C150/A21.50 - Thickness Design of Ductile Iron Pipe
 - 5. ANSI/AWWA C151/A21.51 - Ductile Iron Pipe, Centrifugally Cast, for Water
 - 6. AWWA C504 - Rubber Seated Butterfly Valves
 - 7. AWWA C800 - Underground Service Line Valves and Fittings
 - 8. AWWA C905 - PVC Pressure Pipe and Fabricated Fittings, 14 Inch Through 48 Inch
 - 9. AWWA M23 - PVC Pipe Design and Installation Manual
 - 10. ANSI/AWWA C104/A21.4 - Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water
 - 11. ANSI/AWWA C110/A21.10 - Ductile Iron and Gray Iron Fittings, 3 Inch Through 48 Inch, for Water
 - 12. ANSI/AWWA C153/A21.53 - Compact Ductile Iron Fittings for Water Service
 - 13. AWWA C502 - Dry Barrel Fire Hydrants
 - 14. AWWA C508 - Swing Check Valves for Waterworks Service, 2 Inch Through 24 Inch
 - 15. AWWA C509 - Resilient Seated Gate Valves for Water Supply Service

16. AWWA C515 – Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
17. AWWA C518 – Dual Disc Swing Check Valves for Waterworks Service
18. AWWA C550 – Protective Epoxy Interior Coatings for Valves and Hydrants
19. AWWA C600 – Installation of Ductile Iron Water Mains and Their Appurtenances
20. AWWA C605 – Underground Installation of PVC Pipe and Fittings for Water
21. AWWA C651 – Disinfecting Water Mains
22. AWWA C900 – PVC Pressure Pipe, and Fabricated Fittings, 4 Inch Through 12 Inch, for Water Distribution
23. AWWA C901 – Polyethylene Pressure Pipe and Tubing, ½ Inch Through 3 Inch for Water Services
24. AWWA C906 – Polyethylene Pressure Pipe and Fittings, 4 Inch Through 63 Inch for Water Distribution and Transmission

B. American Society for Testing and Materials (ASTM) latest edition:

1. ASTM A307 - Carbon Steel Bolts and Studs
2. ASTM A536 - Ductile Iron Castings
3. ASTM D1784 - Rigid PVC Compounds and CPVC Compounds
4. ASTM D1785 - PVC Plastic Pipe, Schedules 40, 80 and 120
5. ASTM D2000 - Classification System for Rubber Products in Automotive Applications
6. ASTM F1674 - Test Method for Joint Restraint Products for Use with PVC Pipe

1.03 SUBMITTALS

- A. Product data for gaskets, pipe, joints, joint restraint, fittings, valves, coatings.
- B. Product data for all locate wire, tape, markers, warning tape.
- C. Piping specialties and installation details.
- D. Product data and painting schedule for field applied paint and coatings.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

Exercise care in transporting and handling pipe and fittings in to avoid damage to materials or coatings. Lifting shall be by hoist or on skids when hand lifting is not feasible. Dropping shall not be permitted. Store pipe as recommended by the manufacturer. Damaged pipe and fittings shall be replaced.

PART 2 PRODUCTS

2.01 DUCTILE IRON PIPE

- A. Buried pipe shall conform with ANSI/AWWA C150/A21.50 and C151/ A21.51, and shall have a minimum working pressure of 150 psi. Buried pipe shall comply with the following pressure class (PC) designations unless otherwise indicated on the Drawings:

1. 12 inch diameter and smaller = PC 350
 2. 14 inch through 24 inch diameter = PC 250
 3. 30 inch through 64 inch diameter = PC 200
- B. Exposed pipe 4" and larger shall be flanged and shall conform with AWWA/ANSI C115/A21.15, and shall have a minimum working pressure of 150 psi. Flanged pipe shall comply with the following thickness class (TC) designations unless otherwise indicated on the Drawings:
1. 4 inch diameter = TC 54
 2. 6 inch through 24 inch diameter = TC 53
- C. All flanges shall be class 125, and shall be fully machine faced after being screwed tightly on the pipe. Bolts and nut shall conform to ASTM A307, Grade B.

2.02 FITTINGS FOR DUCTILE IRON AND PVC PIPE

- A. Fittings shall be manufactured of ductile iron, conforming to ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53.
- B. All full body (C110/A21.10) fittings shall be pressure rated to 250 psi, minimum. All compact fittings (C153/A21.53) shall be pressure rated to 350 psi, minimum.
- C. Fitting joints shall be compatible with the type of pipe in use or specified, e.g., flange fittings for flange pipe and mechanical joint for mechanical joint pipe and push-on joint pipe.

2.03 LININGS AND COATINGS FOR DUCTILE IRON PIPE AND FITTINGS

- A. Line the interior of the pipe and fittings with an amine cured novalac epoxy containing at least 20 percent by volume of ceramic quartz pigment, Protecto 401 ceramic epoxy.
- B. Exterior coating for buried pipe and fittings shall be a petroleum asphaltic coating in accordance with ANSI/AWWA C110/A21.10.
- C. Exterior coating of exposed pipe and fittings shall be factory applied rust inhibiting epoxy primer, minimum 3 mils dry film thickness. After installation, exterior surfaces shall be painted with two coats Tnemec Series 2 Tneme-Gloss, Glidden Life Master Pro High Performance Acrylic No. 6900 Series, or equal, at minimum 4 mils dry film thickness per coat. Paint color to be in accordance with local utility requirements and shall match the colors of the existing piping at the facility.
- D. All above ground potable water mains and appurtenances shall be painted safety blue. All above ground influent force mains and appurtenances shall be painted green. All process piping and appurtenances shall be painted gun metal grey.

2.04 JOINTS FOR DUCTILE IRON PIPE AND FITTINGS

- A. Mechanical and push-on joints shall be rubber gasketed, conforming to ANSI/AWWA C111/A21.11. Mechanical joint bolts and nuts shall conform to ASTM A307, Grade B. Ductile iron glands shall be provided with ductile iron pipe.
- B. Lubricants other than that furnished by the pipe manufacturer with the pipe shall not be used.

2.05 RESTRAINED JOINTS FOR DUCTILE IRON PIPE AND FITTINGS

- A. Restrained joints shall be in accordance with DIPRA, "thrust restraint designed for Ductile Iron Pipe," utilizing laying condition 3, a pressure of 150 psi or greater, the type soil encountered, and the depths of the cover shown on the drawings.
- B. Restrained joints shall be American Fast Grip Gasket, Flex-ring, Field Flex Ring, Lok-Ring, US Pipe TR-Flex, EBAA Megalug, or equal.
- C. Pipe joints shall be restrained upstream and downstream of fittings in accordance with the manufacturer's requirements or the table shown in the drawings, whichever is greater.

2.06 SCHEDULE 40, 80 AND 120 PVC PIPE AND FITTINGS

- A. Pipe shall be manufactured from PVC 1120 and shall conform to ASTM D1785. Nominal size of pipe shall be as indicated on the Drawings.
- B. Joints may be either solvent weld type or push-on joints using gasket approved by the Engineer. The bell shall be integral with the pipe and of equal or greater pressure rating. The bell of pipe and fittings using push-on joints shall have an integral groove to retain the gasket in place.
- C. Fittings shall be manufactured of the same material as the pipe and shall have the same type of joints. Schedule 40 fittings shall conform to ASTM D2466. Schedule 80 fittings shall conform to ASTM D2467.
- D. Provide adapters as required to join PVC pipe-to-pipe, fitting, and equipment of other materials.
- E. Solvent cement shall be as recommended by the pipe manufacturer and shall conform to ASTM D2564.
- F. Pipe and fittings shall be NSF approved for the usage to which they will be applied.

2.07 PVC PRESSURE PIPE

- A. Pipe 4 inch through 12 inch diameter shall conform to AWWA C900.
- B. Pipe 14 inch through 36 inch diameter shall conform to AWWA C905.
- C. Pipe shall conform to ASTM D1784, Type I, Grade I, 4000 psi design stress, and shall be National Sanitation Federation (NSF) approved.

- D. Water main and reclaimed water main pipe shall be class 150 (DR18), fire mains shall be class 200 (DR 14). All pipe shall contain markings on each section showing conformance to the above specifications.
- E. PVC pipes shall be color coded and stenciled (2 inch lettering on two sides of the pipe in at least three areas per pipe section) in accordance with the following:
 - 1. PVC Water Main - Blue pipe, stenciled "Potable Water Main".
 - 2. PVC Reclaimed Water Main - Purple pipe, stenciled "Reclaimed Water Main".

2.08 PVC PRESSURE PIPE JOINTS

- A. Joints shall be rubber gasketed conforming to AWWA C900 or C905
- B. The bell shall be integral with the pipe and of equal or greater pressure rating. The bell of pipe and fittings using push-on joints shall have an integral groove to retain the gasket in place.
- C. Provide adapters as required to join PVC pipe to pipe, fittings and equipment of other materials.

2.09 RESTRAINED JOINTS FOR PVC PRESSURE PIPE

- A. Mechanical devices shall be full circumferential contact compression type consisting of two rings connected across the pipe joint with restraining rods and associated hardware.
- B. The pipe bell ring shall be a single piece ductile iron retainer ring that slides over the pipe bell end up to the pipe bell. The pipe plain end ring shall be a two piece ductile iron restrainer with a serrated-face to contact the pipe.
- C. The restrainer shall be assembled on the pipe with side clamping bolts and nuts. The design tolerances to which the restrainer is machined will prevent over-tightening which would weaken or damage the pipe.
- D. Ductile iron rings shall be ASTM A536, Grade 65-45-12. Connecting bolts shall be in accordance with ANSI/AWWA C111/A21.11.
- E. The restraining devices shall be rated for a working pressure equivalent to the pressure rating of the pipe and shall meet or exceed the requirements of ASTM F1674. The devices shall be Uni-Flange Block Buster Series 1350 or Engineer approved equal.

2.10 GENERAL VALVE REQUIREMENTS

- A. Unless otherwise indicated or specified, all valves two inches and smaller shall be all brass or bronze; valves over two inches shall be iron body, fully bronze or bronze mounted.

- B. Where required for satisfactory operation of valves, provide valve operators, extension stems, stem guides, cast iron valve boxes, floor boxes, handwheels, operator stands, position indicators, and other valve appurtenances. Extension stems shall be complete with guide bearings, wrench nut, and tee handle wrench. All machinery stuffing boxes shall be packed with material selected for the service intended. Maintain all packing until final acceptance by the Owner.
- C. Manufacturer's name, service, and pressure marking shall be cast into the body.
- D. Valve operators shall be sized for operation at the pressure and flow conditions required for proper operation.
- E. Manual operators for exterior buried valves shall conform to AWWA C504.
- F. Valve shafts shall be one piece extended completely through the disc or stub shafts extending 1½ times the shaft diameter into the disc. Valve shaft diameter shall be as required by AWWA C504. Valve shafts shall be 304 or 316 stainless steel. Disc to stem connections or turned down portions of shafts shall be designed to transmit shaft torque equivalent to 75% of the required shaft diameter. Bushings shall be of reinforced Teflon, luberized bronze, or stainless steel. Seals may be preloaded by packing gland mechanism.
- G. Manual valve operators shall be designed to hold the valve disc in any intermediate position between fully opened and fully closed without creeping or fluttering. The operator shall be capable of transmitting sufficient torque to open or close each valve under the most adverse operating conditions. An indicating arrow shall be provided to give full closed, full open, or intermediate disc position indicators.
- H. Extension stems shall be provided for all valves in buried locations and in other locations where indicated on the Drawings.
- I. Extension stems shall be fabricated from solid steel shafting not smaller in diameter than the stem of the valve. Stem couplings shall be both threaded and keyed to the coupled stems and shall be of standard design and construction. Pipe couplings will not be acceptable.
- J. Stems for buried valves shall extend to within 6 inches of the surface of the ground. Each extension stem shall be connected to the valve operator with a suitable universal joint type coupling. All connections shall be pinned. Each extension stem shall be provided with spacers which will center the stem in a valve box having an inside diameter of approximately 5 inches, and shall be equipped with a standard AWWA wrench nut as described in AWWA C500, except where handwheels are indicated.

2.11 LININGS AND COATINGS FOR VALVES

- A. Valves 4 inches and larger shall be lined and coated.
- B. Interior of valves shall be coated with a rust inhibiting epoxy primer, followed by a coal tar epoxy, total minimum dry film thickness of 16 mils, applied at the factory.

- C. Exterior coating on buried valves shall be rust inhibiting epoxy primer, followed by a coal tar epoxy, total minimum dry film thickness of 16 mils, applied at the factory.
- D. Exterior coating of exposed valves shall be factory applied rust inhibiting epoxy primer, minimum 3 mils dry film thickness. After installation, exterior surfaces shall be painted with two coats Tnemec Series 2 Tneme-Gloss, Glidden Life Master Pro High Performance Acrylic No. 6900 Series, or equal, at 4 mils minimum dry film thickness per coat. Paint color to be in accordance with local utility requirements.

2.12 GATE VALVES

- A. Gate valves 3 inches and larger shall be resilient seat gate valves, conforming to AWWA C509. The valve body, bonnet, and bonnet cover shall be cast iron ASTM A126, Class B. All ferrous surfaces inside and outside shall have a fusion-bonded epoxy coating.
- B. Tapping valves and sleeves shall be approved AWWA type of the size required. Valves shall conform to the requirements of AWWA C509.
- C. Valves shall have an unobstructed waterway equal to or greater than the full nominal diameter of the valve.
- D. All valves will have 250 psig working pressure and a 500 psi static test pressure. The valves shall be non-rising stems and the stem material shall be 18-8 stainless steel, Type 304, ANSI 420/ASTM A276 with no measurable level of lead content. Valves shall have two upper o-ring seals on the stem above the thrust collar and at least one o-ring seal below the collar so designed to allow for replacement of the upper o-rings with the valve under full operating pressure. Valves shall have thrust washers located above and below the thrust collar to insure a smooth frictionless operation.
- E. All valves shall have a 2 inch ductile iron wrench nut with direction of valve operation clearly visible when looking down on the nut. Hold down nut or bolt shall be Type 316 stainless steel. All exterior bonnet and thrust collar fasteners, whether recessed or exposed, are to be Type 316 stainless steel and marked by type.
- F. The water way seat area will be smooth without ridges or cavities and valves will have full size bore throughout the flow-way. All valves will be hydrostatically pressure tested prior to shipment in accordance with AWWA C509 and are to be covered by the Manufacturer's Ten Year Limited Warranty from the date of purchase by the end user.
- G. The resilient sealing mechanism shall provide zero leakage at test and normal working pressure when installed with the line flow from either direction.
- H. Gate valves larger than 12 inches shall be resilient seated, wedge valves with bevel gear and side actuators.
- I. Standard gate valves 2-½ inches and smaller shall be Class 150 bronze gate valves by Powell Valves or approved equal.

- J. Gate valves 3"-12" shall be American Flow Control Series 2500, Clow Series F-6100. Or Mueller Series A-2360.
- K. Gate valves larger than 12" shall be American Flow Control Series 2500 or Mueller Series A-2361.

2.13 AIR RELEASE VALVES

- A. Air release valves shall be single body combination air release valves designed to release large quantities of air at start up, admit air on shut down, and release air in operation. Air release valves shall be made of a cast iron body, cover and baffle, stainless steel float, bronze water diffuser Buna-N or Viton seat and stainless steel trim. Fittings from the main to the air release valve in the enclosure shall be threaded and made of brass.
- B. Air release valves shall be capable of withstanding operating pressures of 150 psi.
- C. Valves shall be ARI D-025.

2.14 SWING CHECK VALVES

- A. Below grade horizontal swing check valves shall be cast iron, bronze mounted and conform to AWWA C508.
- B. Above grade check valves shall be dual disk swing check valves with an external weighted lever, and shall conform to AWWA C518. Ends shall be flanged joint. Valves shall be furnished with all jointing accessories.
- C. Acceptable Manufacturers: Kennedy, M&H, or Mueller

2.15 BUTTERFLY VALVES

- A. Butterfly valves shall meet or exceed the design strength, testing and performance requirements of AWWA C504, Class 150.
- B. Valve body shall be mechanical joint end type valve constructed of cast iron or ductile iron.
- C. Disc shall be one piece cast design with no external ribs transverse to flow. Disc shall be cast iron or ductile iron.
- D. The resilient seat shall be bonded to the valve body and shall mate with a 304 or 316 stainless steel surface.
- E. Valve seats for valves 14 inch diameter and larger shall be mechanically retained, and may be installed on either the body or disc. O-ring seats on valve discs are unacceptable. Seats for valves 14 inch diameter and larger shall be fully field replaceable without the use of special tools.

- F. Operators of the enclosed traveling-nut type shall be provided unless otherwise indicated.
- G. Valve shafts shall be one piece extended completely through the disc or stub shafts extending 1 ½ times the shaft diameter into the disc. Valve shaft diameter shall be as required by AWWA C504. Valve shafts shall be of 304 or 316 stainless steel. Disc to stem connections or turned down portions of the shafts shall be designed to transmit shaft torque equivalent to 75% of the required shaft diameter. Bushings shall be of reinforced Teflon, lube-sized bronze, or stainless steel. Seals may be preloaded by packing gland mechanism.
- H. Manual valve operators shall be designed to hold the valve disc in any intermediate position between fully opened and fully closed without creeping or fluttering. The operator shall be capable of transmitting sufficient torque to open or close each valve under the most adverse operating conditions. An indicating arrow shall be provided to give full closed, full open, or intermediate disc position indicators.
- I. Valves shall be Pratt, Mueller Linesal III, or DeZurik BAW.

2.16 PLUG VALVES

- A. Standard plug valves shall be of the eccentric design which allows a minimum of 80 percent cross sectional area of the pipe for 4 inch diameter and smaller and increasing cross sectional area up to 100 percent for pipe 20 inch diameter and larger. The valve body shall be semi-steel, with a welded-in corrosion-resistant nickel seat. Plug shall be faced with resilient hycar having oil impregnated stainless steel bushings. Buried plug valves shall be non-lubricated type, and non-buried plug valves shall be lubricated type.
- B. Valves shall be furnished with replaceable chevron packing, capable of being repacked with the line under pressure.
- C. Valves 4 inches in diameter and smaller shall be lever or wrench nut operated. Valves larger than 4 inches shall be worm gear operated, except where automatic operation is specified.
- D. Standard plug valves shall be DeZurik Series PEC.

2.17 CORPORATION STOPS

Corporation stops shall be 1 inch, 1½ inch or 2 inch brass, equipped with connections suitable for service piping. Conformance with AWWA C800 and C901 is required.

2.18 CURB STOPS

Curb stops shall be manufactured of 85-5-5-5 bronze conforming to ASTM B62. Curb stops shall be sized to match the meter size. Conformance with AWWA C800 and C901 required.

2.19 VALVE BOXES

- A. All buried valves shall be provided with adjustable valve boxes approximately 5 inches in diameter with a minimum thickness of 3/16 inch and constructed so that the removable cover will not be thrown out by travel over it. Valve boxes shall be of sound, close grained cast iron, free from flaws and defects, built strong and rugged enough to withstand the shock of street traffic.
- B. Valve boxes shall be of sufficient length to operate all valves buried in the ground. Valve boxes shall consist of base, center section, and top section with cover.
- C. Valve boxes located in unpaved areas shall be Slip Type design to permit movement of the top section without transmitting forces onto the valve body.
- D. All valve box covers shall be painted in an approved manner with the primer paint being Kopper's "Glamortex" no. 622 rust primer and the finish paint shall be two coats of enamel to color as required by the utility company.

2.20 PIPELINE IDENTIFICATION TAPE

- A. On buried piping identification tape shall be an inert plastic film specifically formulated for prolonged underground use. Minimum thickness 4 mils, width 6 inches, letter size 1 inch. Lettering shall be continuous.
- B. Tape shall be the standard product of a manufacturer regularly engaged in the supply of this tape. Provide tape with adhesive backing for attachment to pipe.
- C. On above ground piping, identification tape shall be 4 inch yellow tape with 2 inch black lettering. Piping shall be identified with arrows indicating the direction of flow and the purpose of the pipe.

2.21 PIPELINE WARNING TAPE

- A. Warning tape shall be 6 inch wide vinyl continuous tape, for identification and warning purposes. It shall be color coded based on the service of the pipe and worded "CAUTION: BURIED PIPELINE BELOW"

2.22 LOCATING WIRE

Locating wire shall be color-coded with 10 gage continuous insulated wire. Color coding shall be in accordance with standard identification coloring.

PART 3 EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

- A. All lengths of pipe shall be dimensioned accurately to measurements established at the site, and shall be worked into place without springing or forcing.

- B. Cut all pipe and drill all holes that may be necessary. Cut sections of pipe shall be reamed or filed to remove all burrs. The pipe interior and joints shall be thoroughly cleaned before being installed and kept clean during construction.
- C. All changes in direction shall be made with fittings or approved joint deflection. Bending of pipe, except copper and polyethylene, is prohibited. Joint deflection shall not exceed 75 percent of the manufacturer's recommended maximum deflection.
- D. Any transition from one pipe size to another shall be made with a reducing fitting. Reducing bushings are prohibited except where specifically indicated on the Drawings or approved by the Engineer.
- E. Make adequate provision for expansion and contraction of piping.
- F. Trenching, bedding and backfilling shall be in accordance with Section 02320.
- G. Valves shall be installed in all pipe ahead of appliances and equipment not furnished with stops, and elsewhere as required for proper control and isolation of sections of systems for maintenance purposes.
- H. Minimum cover over pipe shall be 36 inches.

3.02 CONCRETE CRADLES AND ENCASEMENT

Concrete cradles and encasement shall be as indicated on the drawings, or as directed by the Engineer. All concrete cradles and anchors shall be of Class B concrete.

3.03 PLUGS

- A. Installed piping systems shall be temporarily plugged at the end of each day's work, or other interruption to progress on a given line. Plugging shall be adequate to prevent entry of small animals or persons into the pipe or the entrance or insertion of deleterious materials.
- B. Standard plugs shall be inserted into all dead-end pipes, tees, or crosses; spigot ends shall be capped; flanged and mechanical joint ends shall have blind flanges of metal.
- C. Plugs installed for pressure testing shall be blind flanges fully secured and blocked to withstand the test pressure.
- D. Where plugging is required because of contract division or phasing for later connection, the ends of such lines shall be equipped with a permanent type plug or blind flange. Installation or removal of such plugging shall be considered incidental to the work.

3.04 DUCTILE IRON PIPE

- A. Mechanical joints: install according to the manufacturer's specifications. Socket and gasket shall be clean and gasket shall be properly centered before joint is made.
- B. Push-On Type Joints: Remove any foreign matter in the gasket seat, wipe gasket clean, flex and place in socket. Apply thin film of lubricant to inside surface of gasket. Complete joint assembly by forcing the plain end of the entering pipe past the gasket until it makes contact with the bottom of the socket.
- C. Flanged Joints: Bolt flanged joints with care so there is no restraint on the opposite end of the piece, which would prevent pressure from being evenly and uniformly applied upon the gasket. The pipe or fitting must be free to move in any direction while bolting. Gradually tighten bolts, each in turn, at a uniform rate of gasket compression around the entire flange.

3.05 O-RING TYPE PUSH-ON JOINTS FOR PVC PIPE

- A. Clean the pipe end and the bell thoroughly. Insert O-Ring gasket, making certain it is properly oriented. Lubricate the spigot well with an approved lubricant; do not lubricate the bell or O-ring. Insert the spigot end of the pipe carefully into the bell until the reference mark on the spigot is flush with the bell.
- B. Field cut pipe shall be beveled, have all burrs removed, and shall have a reference mark applied the correct distance from the end.

3.06 SOLVENT CEMENT JOINTS FOR PLASTIC PIPE

- A. Bevel the pipe end and remove all burrs before making joint. Clean both pipe and fittings thoroughly. Do not attempt to make solvent cement joints if temperature is below 40 degrees F nor in wet conditions.
- B. Apply a complete coating of primer to the outside surface of the pipe end and to the mating inside surface of the socket. Apply a liberal coat of solvent cement to the pipe and socket. Immediately after application of cement, insert the pipe to the full depth of the socket while rotating the pipe or fitting 1/4 turn to evenly spread the cement. Hold joint together for a minimum of 10 to 15 seconds to insure pipe does not back out of socket. Immediately after joining, wipe all excess cement from the pipe and fittings leaving only a small bead of cement around the circumference of the joint. The joint shall be allowed to set for a minimum one half hour before handling.
- C. Due to the explosive hazard, the following safety precautions shall be observed in conjunction with the use of solvent weld plastic pipe:
 - 1. Air shall be permitted to circulate through the pipeline to permit solvent vapor to escape.
 - 2. When flushing or filling pipelines, admit water slowly to prevent compression of the gases within pipe.

3.07 BURIED AND EXPOSED VALVES

- A. Buried valves 6 inch diameter and larger shall be set on a foundation of solid concrete or stone not less than 8 inches thick nor less than one cubic foot in volume. Foundations shall be set on firmly compacted ground.
- B. The height of the valve and its supporting foundation shall conform to the height of the connecting pipe. Valves shall be set in a vertical position unless otherwise indicated on the Drawings.
- C. Exposed valves shall be installed in a vertical position wherever possible. Unless otherwise indicated or directed by the Engineer, valve stems shall never be below a horizontal position.
- D. Open and close each valve observing full operation prior to installing successive lengths of pipe.

3.08 AIR RELEASE VALVES

Air release valves shall be placed at high points of the pipeline to permit escape of trapped air. The valve size, location and method of installation shall be indicated on the Drawings or as directed by the Engineer.

3.09 VALVE BOXES

- A. Boxes shall rest on the valve and shall be adjusted so that the cover may be set flush with paving; in areas without paving, set the cover as directed by the Engineer. Boxes shall be set to allow equal movement above and below finish grade.
- B. The base of the box shall be centered over the valve, and the top of the base section shall be approximately on line with the nut on top of the valve stem. The entire assembly shall be plumb.

3.10 INSTALLATION OF IDENTIFICATION AND WARNING TAPE

- A. Install identification tape on all pipelines. Place tape as follows:
 - 1. 2 inch through 8 inch diameter pipe - center along top half of pipe
 - 2. 10 inch through 18 inch diameter pipe - place along both sides of the top half of pipe
 - 3. 20 inch diameter and larger pipe - place on both sides of top half of pipe with a third strip centered along top half of pipe
- B. Place tape from joint to joint on every section of buried pipe.
- C. Install warning tape along all pipelines. Install 2 feet above pipe, minimum of 1 foot below grade.
- D. Place marking tape every ten feet on above ground piping unless otherwise approved by the OWNER.
- E. Identification tape shall indicate purpose of the pipe and the direction of flow.

3.11 LOCATOR WIRE

- A. Install locator wire along all pressurized pipelines 2 inch diameter and larger.
- B. Terminate locator wires at top of the valve box with 12" of extra wire.
- C. Test the locate wire for continuity and submit report documenting the continuity testing. Repair or replace locate wire at failed test locations as directed by Owner.

3.12 TESTING GENERAL REQUIREMENTS

- A. Test procedures and method of disposal of water shall be approved by the Engineer. All tests shall be made in the presence of the Engineer and utility. Preliminary tests made by the Contractor without being observed by the Engineer will not be accepted. Notify the Engineer and the utility companies at least 48 hours before any work is to be inspected or tested.
- B. All defects in piping systems shall be repaired and/or replaced and retested until acceptable. Repairs shall be made to the standard of quality specified for the entire system.
- C. Sections of the system may be tested separately, but any defect which may develop in a section previously tested and accepted shall be promptly corrected and retested. Pressure tests shall be made between valves to demonstrate ability of valves to sustain pressure.
- D. Provide all necessary test equipment. Increments on gages used for pressure pipe testing shall be of scaled to the nearest 1 psi. Gages, pumps, and hoses shall be in good working order with no noticeable leaks.
- E. Tests for any exposed piping shall be made before covering and insulation is placed.
- F. The pressure and leakage test for buried piping shall be made after all jointing operations are completed and restraints have been in place at least seven days. Lines tested before backfill is in place shall be retested after compacted backfill is placed.
- G. All service connections to water and reclaimed water mains shall be completed prior to testing.
- H. Sections of piping between valves and other short sections of line may be isolated for testing. If shorter sections are tested, test plugs or bulkheads required at the ends of the test section shall be furnished and installed by Contractor, together with all anchors, braces, and other devices required to withstand the hydrostatic pressure without imposing any thrust on the pipe line. Contractor shall be solely responsible for any damage that results from the failure of test plugs or supports.
- I. All items including valves and controls shall be given a thorough test. The entire system shall be operated for two days to prove compatibility of equipment and to

achieve proper adjustment for operation. Valves, pipes, tanks, and other items that are non-operating or occasional-operating shall be tested for ability to meet design criteria.

3.13 PRESSURE AND LEAKAGE TESTING (PVC AND DI MAINS)

- A. Piping shall be slowly filled with water and all air expelled. Care shall be taken that all air valves are installed and open in the section being filled, and that the rate of filling does not exceed the venting capacity of the air valves.
- B. Apply hydrostatic test pressure of 150 psi (water mains), 200 psi (fire mains) or 100 psi (reclaimed water mains) for 10 minutes and for such additional period necessary for the Engineer to complete the inspection of the line under test. Do not exceed pipe manufacturer's suggested time duration at the test pressure. If defects are noted, repairs shall be made and the test repeated until all parts of the line withstand the test pressure.
- C. Apply leakage test pressure of 150 psi (water mains), 200 psi (fire mains) or 100 psi (reclaimed water mains). Maintain pressure at a maximum variation of 5 percent during the entire leakage test. The duration of the leakage test shall be two hours minimum, and for such additional time necessary for the Engineer to complete inspection of the section of line under test. Leakage measurements shall not be started until a constant test pressure has been established. The line leakage shall be measured by means of a water meter installed on the supply side of the pressure pump.
- D. No leakage is allowed in exposed piping, buried piping with flanged, threaded, or welded joints or buried non-potable piping in conflict with potable water lines.
- E. Tested sections of buried piping with slip type or mechanical joints will not be accepted if it has a leakage rate in excess of that rate determined by the formula:

$$\text{AWWA C-600 Ductile Iron Mains} \quad L = \frac{SD\sqrt{P}}{133200}$$

$$\text{AWWA C-605 PVC Mains} \quad L = \frac{ND\sqrt{P}}{7400}$$

L = Maximum permissible leakage rate, in gallons per hour, throughout the entire length of line being tested.

S = Length of line tested (in feet).

D = Nominal internal diameter (in inches) of the pipe.

\sqrt{P} = The square root of the actual pressure in psig on all joints in the tested portion of the line. This actual pressure shall be determined by finding the difference between the average elevation of all tested pipe joints and the elevation of the pressure gauge and adding the difference in elevation head to the authorized test pressure.

N = Number of joints along pipeline being tested.

- F. All apparent leaks discovered within one year from the date of final acceptance of the work by the Owner shall be located and repaired by Contractor, regardless of the total line leakage rate.

END OF SECTION

SECTION 34 70 00
FDOT STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, DATED
2022

PART 1 - GENERAL

1.1 Purpose

- A. The purpose of this Section is for the adoption by Reference of, The **Florida Department of Transportation Standard Specifications for Road and Bridge Construction, 2022 Edition (FDOT Standard Specifications)**, for Technical Criteria and Description of the Division II – Construction Details, and Division III - Materials, which are typically associated with roadway construction and related work.
- B. Adoption of these FDOT Standard Specifications shall not be limited to roadway construction, but may include but not be limited to, Paving, Grading, and Drainage improvements related to Site Work/Civil Projects of the Greater Orlando Aviation Authority, as applicable.
- C. Unless specifically stated otherwise, Division 1 of this Project Manual, take precedence over the applicable sections of the FDOT Standard Specifications, i.e. Division I – General Requirements and Covenants.

1.2 Related Documents

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections including sustainability requirements, apply to this Section.
- B. When the FDOT Standard Index Drawings are referenced on the Drawings or in the Contract Documents, the work or item shall comply with the Florida Department of Transportation Design Standards for Design, Construction, Maintenance and Utility Operations on the State Highway System, 2022 Edition, except as specifically modified elsewhere in the Contract Documents.

PART 2 – DEFINITIONS

2.1 Definition of Terms

- A. The following paragraphs redefine the FDOT terms (as listed in Division I, Part 1) to be consistent with the Contract Documents.
 - 1. **Contractor** shall mean the entity entering into the Contractual Agreement with the Greater Orlando Aviation Authority for the execution and delivery of the project.
 - 2. **Contractor's Engineer of Record** shall mean an Engineer, Licensed by the State of Florida, hired by the Contractor to perform Professional Engineering Design Services related to the project. Submittals made by the Contractor's Engineer of Record to the Owner under the provisions of Division 1, shall carry his/her signature, date and seal. (**Related Definition: Contractor's Surveyor** shall mean a Surveyor hired by the

- Contractor to perform project related services, such as but not limited to, staking and layout of lines and grades of the work, and recording As-Built (As-Constructed) conditions. Submittals made by the Contractor's Surveyor to the Owner under the provisions of Division 1, shall be prepared from a Florida Licensed Surveyor, and shall carry his/her signature, date and seal.)
3. **Department**, where used to denote an approved plant, material, product, or similar reference, shall mean the Florida Department of Transportation. Where used to denote the Contracting Entity, it shall mean the Greater Orlando Aviation Authority, or the Owner.
 4. **Engineer** shall mean the Greater Orlando Aviation Authority, Department of Engineering and Construction, or their duly authorized representative, (Owner's Authorized Representative, or OAR).
 5. **Engineer of Record** shall mean the Professional Engineer or Engineering Firm that develops the criteria and concept for the project, performs the analysis, and is responsible for the preparation of the Plans (Drawings) and Specifications of the work.
 6. **Inspector** shall mean a duly authorized entity of the Greater Orlando Aviation Authority, the OAR, the Engineer of Record, and/or the City of Orlando, assigned to make official inspections of the materials furnished and of the work performed by the Contractor. Additional Inspection Oversight may be performed by any Authority Having Jurisdiction (AHJ), including but not limited to the Water Management District, Florida Department of Environmental Protection, etc.
 7. **Laboratory** shall mean any official testing laboratory used by the Greater Orlando Aviation Authority, the OAR, the Engineer of Record, and/or the City of Orlando. (**Related Definition: Contractor's Laboratory** shall have a similar definition representing the Contractor for Quality Control purposes, and/or for confirmation/comparison to the Laboratory's testing results.)
 8. **Right of Way** shall not be limited to defined limits of titled land around a roadway. As used in the FDOT Standard Specifications, Right of Way shall encompass all areas where the specified work is depicted in the Contract Documents.
 9. **Secretary** shall mean the Greater Orlando Aviation Authority, Department of Engineering and Construction, or their OAR.
 10. **Specialty Engineer**: See **Contractor's Engineer of Record**, except used for the design and drawing preparation of components, systems, or installation methods and equipment for specific temporary portions of the work, or for special items of the permanent works not fully detailed in the plans and required to be furnished by the Contractor such as but not limited to foundation designs, non-standard expansion joints, MSE wall designs, and other specialty items.

END OF SECTION 34 70 00