PROJECT MANUAL

INCLUDING CONSTRUCTION SPECIFICATIONS

for

V-S035, - TERMINAL C ASC LEVEL 2 EMERGENCY EGRESS (D/B)

ORLANDO INTERNATIONAL AIRPORT

Orlando, Florida 32827

CONTRACT DOCUMENTS

Issue Date

February 21, 2023

VOLUME 10 OF 10

GREATER ORLANDO AVIATION AUTHORITY

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SECTION 28 05 00 - COMMON WORK ELEMENTS FOR ESS

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 28 Specification Sections.

B. Related Sections:

1. 26 05 00 – Common Work Results for Electrical
2. 26 05 19 – Building Wire and Cable
3. 26 05 26 – Grounding and Bonding
4. 26 05 29 – Hangers and Supports
5. 26 05 33 – Conduit
6. 26 05 34 – Outlet Boxes
7. 26 05 35 – Pull & Junction Boxes
~~8. 26 05 43 – Underground Ducts & Raceways For Electrical Systems~~
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~~13.~~12. 27 51 13 – Emergency Communication System
~~14.~~13. 28 08 00 – Commissioning of Life Safety and Security Systems
~~15.~~14. 28 13 00 – Physical Access Control System
~~16.~~15. 28 16 00 – Intrusion Detection System
~~17.~~16. 28 23 00 – Video Surveillance System
~~18.~~17. 28 31 00 – Addressable Fire Detection and Alarm

C. Reference Symbols:

1. All device symbols are defined by the appropriate symbol schedules. Because of the scale of the drawings, symbols are shown on drawings as close as possible to the mounting location. Not all device symbols as indicated may be required for the project.
   a. Contractor shall coordinate exact locations with all architectural drawings, mechanical, electrical drawings, communications drawings, reflected ceiling and furniture plans, door hardware specifications as well as all affected trades prior to submittal of any shop drawings.

D. Abbreviations:

1. General: Refer to Specification Section 27 05 00 for Abbreviations.

E. Definitions:

1. General: Refer to Specification Section 27 05 00 for Definitions

1.2 SUMMARY

A. General: Refer to Specification Section 27 05 00 for all requirements.

1.3 SCOPE OF WORK

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

B. Refer to individual Specification Sections for further system requirement.

1.4 REFERENCES

A. General: Refer to Specification Section 27 05 00 for all References.

1.5 SYSTEMS DESCRIPTIONS

A. At the minimum, the scopes of work covered by the Division 28 Specifications and the contract drawings shall include but are not limited to the following systems. Refer to related drawings and specifications for additional information.

1. The Division 28 Contractor shall be responsible for providing the proper installation, termination, programming, testing, commissioning, certification, modifications to existing North Terminal security systems. Include the integration of all related Division 28 systems in accordance with the Contract documents. Refer to all related project drawings and specifications for additional information.

B. The Contractor shall install, program and certify all Physical Access Control System (PACS), servers, central processors, local door controllers, auxiliary power supplies, card readers, client workstations, electrical power, and all appurtenances in accordance with all applicable codes, manufacturers' requirements, project drawings and specifications.

1. At the minimum include the following;
   a. Provide all related servers, central processors, local door controllers, components, cabling, conduits, materials, low voltage electrical power, programming, testing, certifications and all appurtenances as required for the installation of a complete and fully operational Physical Access Control System (PACS) and GOAA Duress Systems. The Contractor shall provide all of the above in accordance with all applicable life safety codes, building codes, as well as all related Specification Sections, drawings and manufacturers recommendations. Contractor to confirm that all PACS and Duress Systems comply with the designed Sequence of Operation.
   b. All Access Control and Duress System controls and devices, cabling as well as all remote sub-systems and/or control panels shall be supervised against unauthorized access, intentional or accidental tampering, deterioration of wiring or connections and operation failures. Any of the above conditions shall result in an audible and visual indication at select GOAA client alarm and admin workstations.
   c. Coordinate with Division 26 to provide all necessary emergency / security 120 VAC circuits as required to provide proper operation of all system components.
   d. The Contractor shall include the integration and programming of all electronic door hardware, fire alarm, video surveillance, network connectivity, and Duress Button systems, in accordance with all applicable codes, manufacturers' requirements, project drawings and specifications.
   e. Provide all necessary modifications to existing North Terminal PACS as well as all related auxiliary systems as required for the seamless integration of the new system,

f. All PACS cabling shall be installed in dedicated raceways unless otherwise specified. All TCP/IP based access control system cabling shall be Category-6 installed in accordance with all requirements of related Specification Sections 27 05 00 and 27 10 00.

C. The Contractor shall design, install, program and certify all Intrusion Detection System (IDS), control panels, keypads, motion detectors, door contacts, auxiliary power supplies, electrical power, and all appurtenances in accordance with all applicable codes, manufacturers' requirements, project drawings, CBP standards, and specifications.

1. At the minimum include the following;
   a. Provide all related IDS Controllers, keypads, door contacts, motion detectors, cabling, conduits, materials, electrical power, programming, testing, certifications and all appurtenances as required for the installation of a complete and fully operational Intrusion Detection System (IDS). The Contractor shall provide all of the above in accordance with all applicable life safety codes, building codes, as well as all related specification sections, drawings and manufacturers recommendations.
   b. All Intrusion Detection System controls and devices, cabling as well as all remote sub-systems and/or control panels shall be supervised against unauthorized access, intentional or accidental tampering, deterioration of wiring or connections and operation failures. Any of the above conditions shall result in an audible and visual indication at all client workstations, network command terminals and UL listed communications equipment.
   c. Coordinate with Division 26 to provide all necessary emergency / security 120 VAC circuits as required to provide proper operation of all system components.
   d. The Contractor shall include the integration and programming of all control panels and keypads in accordance with all applicable codes, manufacturers' requirements, project drawings, CBP standards, and specifications.
   e. All IDS cabling shall be installed in dedicated raceways unless otherwise specified.

D. The Contractor shall install, program and certify all Video Surveillance System (VSS) servers, recording components, cameras, video monitors, power supplies, electrical power and all appurtenances in accordance with all applicable codes, manufacturers' requirements, project drawings and specifications.

1. At the minimum include the following;
   a. Provide all related devices, cameras, components, cabling, conduits, materials, programming, testing, certifications and all appurtenances as well as all emergency power as required for complete and fully operational TCP/IP based Video Surveillance. The Contractor shall provide all of the above in accordance with all applicable electrical codes, communication standards, building codes, related Specification Sections, drawings and manufacturers recommendations.
   b. Coordinate with Division 26 to provide all necessary emergency / security 120 VAC circuits as required to provide proper operation of all system components.

c. The Contractor shall include the integration and programming of all VSS components in accordance with all applicable codes, manufacturers' requirements, project drawings and specifications.
d. Provide all necessary modifications to existing North Terminal VSS as well as all related auxiliary systems as required for the seamless integration of the expanded system,
e. Provide all documentation, testing, commissioning and certifications in accordance with all requirements of the Contract Documents.
f. All VSS cabling shall be installed in dedicated raceways unless otherwise specified. All TCP/IP based access control system cabling shall be Category-6 installed in accordance with all requirements of related Specification Sections 27 05 00 and 27 10 00.
g. Refer to all related Specification Sections for additional system requirements.
h. Contractor to provide mock-up of each camera type installation for GOAA and OAR review and approval prior to installation.

E. The Contractor shall install, program and certify all Fire Alarm controls, processing components, initiating devices, notification appliances, annunciators, power supplies, electrical power and all appurtenances in accordance with all applicable codes, manufacturers' requirements, project drawings and specifications.

1. At the minimum include the following;
a. Provide all related devices, components, cabling, conduits, materials, programming, testing, certifications and all appurtenances as well as all emergency power as required for complete and fully operational fire alarm system. The Contractor shall provide all of the above in accordance with all applicable electrical codes, building codes, related Specification Sections, drawings and manufacturers recommendations.
b. Coordinate with Division 26 to provide all necessary emergency / life safety 120 VAC circuits as required to provide proper operation of all system components.
c. The Contractor shall include the integration and programming of all electronic door hardware, sprinkler, fire suppression systems, smoke control and mechanical systems in accordance with all applicable codes, manufacturers' requirements, project drawings and specifications.
d. Provide all necessary modifications to existing North Terminal Fire Alarm system as well as all related auxiliary systems as required for the seamless integration of the new system,
e. Provide all documentation, testing, commissioning and certifications in accordance with all requirements of the Contract Documents.
f. Refer to all related specification sections for additional system requirements.

1.6 SUBMITTALS

A. General: Refer to Specification Section 27 05 00 for all requirements.

1.7 QUALITY ASSURANCE:

A. General: Refer to Specification Section 27 05 00 for all requirements.

1.8 DELIVERY, STORAGE AND HANDLING

A. General: Refer to Specification Section 27 05 00 for all requirements.

1.9 RECORD DOCUMENTS

A. General: Refer to Specification Section 27 05 00 for all requirements.

1.10 OPERATION AND MAINTENANCE

A. General: Refer to Specification Section 27 05 00 for all requirements.

1.11 SOFTWARE AGREEMENT

A. General: Refer to Specification Section 27 05 00 for all requirements.

1.12 SPARE MATERIALS

A. General: Refer to Specification Section 27 05 00 for all requirements.

1.13 ENVIRONMENTAL CONDITIONS

A. General: Refer to Specification Section 27 05 00 for all requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURED PRODUCTS

A. General: Refer to Specification Section 27 05 00 for all requirements.

PART 3 - EXECUTION

3.1 COORDINATION

A. General: Refer to Specification Section 27 05 00 for all requirements.

3.2 EQUIPMENT PROTECTION

A. General: Refer to Specification Section 27 05 00 for all requirements.

3.3 WORK PERFORMANCE

A. General: Refer to Specification Section 27 05 00 for all requirements.

3.4 EQUIPMENT INSTALLATION

A. General: Refer to Specification Section 27 05 00 for all requirements.

3.5 CABLE INSTALLATION

A. General: Refer to Specification Section 27 05 00 for general requirements in addition to below items:

B. All PACS and IDS security system cabling is to be concealed above ceilings and installed in “dedicated” conduits. All conduits shall be supported above ceilings to the building structure and shall not contain any AC carrying conductors or non-associated security system cables.

1. Provide all access control cabling in accordance with all manufacturers’ requirements.

a. All security conductors shall be twisted pair, minimum 18 AWG unless otherwise noted or required by code, equipment manufacturer and/or noted elsewhere. Refer to related Specification Sections for additional information.
b. Twisted pair, minimum 16 AWG unless otherwise noted or required by code, shall be utilized for control of electrical and motorized doors and gates unless otherwise required by code, equipment manufacturer and/or noted elsewhere. Refer to related Specification Sections for additional information.

C. All VSS cabling is to be concealed above ceilings and installed in dedicated conduit. Provide all Video surveillance system cabling in accordance with all manufacturers' requirements, at the minimum all cabling shall conform to the following:

1. All cabling associated with the installation of the VSS shall utilize Category-6 UTP cables. Refer to related Specification Sections 27 05 00 and 27 1~~1~~0 00 for additional information related to the proper installation of Category-6 UTP cables.
2. Coordinate all system cabling with system provider prior to shop drawing submission.

D. All security system conduits/raceways shall be installed in a manner that prevents tampering or removal when installed in areas exposed to the general population.

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.

3.6 ELECTRICAL POWER DISTRIBUTION

A. General: Refer to Specification Section 27 05 00 for all requirements.

3.7 TRANSIENT VOLTAGE SUPPRESSION

A. General: Refer to Specification Section 27 05 00 for general requirements.

B. All exterior camera locations shall have din rail mounted Bussmann BSPD48RJ45 or approved equal surge suppression located at field device security outlet and Ditek rack mounted DTK-RM12POE or approved equal surge protection in the IDF.

3.8 GROUNDING AND BONDING

A. General: Refer to Specification Section 27 05 00 for requirements.

3.9 EQUIPMENT IDENTIFICATION

A. General: Refer to Specification Section 27 05 00 for requirements.

3.10 MAINTENANCE & SERVICE

A. General: Refer to Specification Section 27 05 00 for requirements.

3.11 WARRANTY

A. General: Refer to Specification Section 27 05 00 for requirements.

3.12 SERVICES

A. General: Refer to Specification Section 27 05 00 for all requirements.

3.13 TRAINING

A. General: Refer to Specification Section 27 05 00 for all requirements.

3.14 PROJECT CLOSEOUT REQUIREMENTS

A. General: Refer to Specification Section 27 05 00 for all requirements.

END OF SECTION 28 05 00

SECTION 28 08 00 - COMMISSIONING OF LIFE SAFETY AND SECURITY SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Owner's Project Requirements (OPR) and the Basis of Design (BOD) documentation are included by reference for information only.

C. Division 01 Section 01 81 13.14 Sustainable Design Requirements – LEED v4 BD+C for additional LEED v4 requirements related to commissioning.

D. ASHRAE standard 90.1-2010 and ASHRAE Guideline 0-2013 (The Commissioning Process) and ASHRAE Standard 202-2013 Commissioning Process for Buildings and Systems.

1.2 SUMMARY

A. This section includes commissioning process requirements for life safety systems, assemblies, and equipment; including fire detection and alarm, smoke control, access control and video surveillance systems.

B. Related Sections:

1. Division 01 Section 01 91 13 "General Commissioning Requirements" for general commissioning process requirements.

1.3 DESCRIPTION

A. Refer to Division 01 Section 01 91 13 "General Commissioning Requirements" for the description of commissioning.

1.4 DEFINITIONS

A. Refer to Division 01 Section 01 91 13 "General Commissioning Requirements" for definitions.

1.5 SUBMITTALS

A. Refer to Division 01 Section 01 91 13 "General Commissioning Requirements" for CxA's role.

B. Refer to Division 01 Section "Submittal Procedures" for specific requirements. In addition, provide the following:

C. In addition, provide the following:

1. Certificates of readiness
2. Certificates of completion of installation, prestart, and startup activities.

3. O&M manuals
4. Test reports

1.6 QUALITY ASSURANCE

A. Test Equipment Calibration Requirements: Contractor will comply with test manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately after instruments have been repaired resulting from being dropped or damaged. Affix calibration tags to test instruments. Furnish calibration records to CxA upon request.

1.7 COORDINATION

A. Refer to Division 01 Section 01 91 13 "General Commissioning Requirements" for requirements pertaining to coordination during the commissioning process.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. All standard testing equipment required to perform startup, initial checkout and functional performance testing shall be provided by the Contractor for the equipment being tested. For example, the specific contractors / subcontractors for the various systems defined under Division 28 shall ultimately be responsible for all standard testing equipment for the respective systems (fire alarm, smoke control, security, etc.) in Division 28. A sufficient quantity of two-way radios shall be provided by each contractor.

B. Special equipment, tools and instruments (specific to a piece of equipment and only available from vendor) required for testing shall be included in the base bid price to the Owner and left on site, except for stand-alone data logging equipment that may be used by the CxA.

C. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the Owner upon completion of the commissioning process.

D. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5°F and a resolution of + or - 0.1°F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year.

PART 3 - EXECUTION

3.1 GENERAL DOCUMENTATION REQUIREMENTS

A. With assistance from the installing contractor, the CxA will prepare construction Verification Checklists for all commissioned components, equipment, and systems, the contractor shall execute the Verification Checklists.

B. Red-lined Drawings:

1. The contractor will verify all equipment, systems, instrumentation, wiring and components are shown correctly on red-lined drawings.
2. Preliminary red-lined drawings must be made available to the Commissioning Team for use prior to the start of Functional Performance Testing.
3. Changes, as a result of Functional Testing, must be incorporated into the final as-built drawings, which will be created from the red-lined drawings.
4. The contracted party, as defined in the Contract Documents will create the as-built drawings.

C. Operation and Maintenance Data:

1. The CM at Risk will provide a copy of O&M literature within 45 days of each submittal acceptance for use during the commissioning process for all commissioned equipment and systems.
2. The CxA and the A/E will review the O&M literature once for conformance to project requirements.
3. The CxA will receive a copy of the final approved O&M literature once corrections have been made by the CM at Risk and the Contractor.

D. Demonstration and Training:

1. CM at Risk and the subcontractor will provide demonstration and training as required by the specifications.
2. A complete training plan and schedule must be submitted by the CM at Risk and the Subcontractor to the CxA a minimum of four (4) weeks prior to any training.
3. A training agenda for each training session must be submitted by the CM at Risk and the Subcontractor to the CxA, the A/E and the OR a minimum of one (1) week prior the training session.
4. The CxA shall be notified at least 72 hours in advance of scheduled tests so that testing may be observed by the CA and Owner's representative. A copy of the test record shall be provided to the CxA, the A/E, and the OR.
5. Engage a Factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specific equipment.
6. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, trouble shooting, servicing, and maintaining equipment.
7. Review data in O&M Manuals.

E. Systems Manual requirements:

1. The Systems Manual is intended to be a usable information resource containing all of the information related to the systems, assemblies, and Commissioning Process in one place with indexes and cross references.
2. The CM at Risk shall include final approved versions of the following information for the Systems Manual:
   a. As-Built System Schematics
   b. Verified Record Drawings
   c. Test Results (not otherwise included in Cx Record)

d. Periodic Maintenance Information for computer maintenance management system
e. Recommendations for recalibration frequency of sensors and actuators
f. A list of contractors, subcontractors, suppliers, architects, and engineers involved in the project along with their contact information
g. Training Records, Information on training provided, attendees list, and any on-going training

3. This information shall be organized and arranged by building system, such as fire alarm, chilled water, emergency power system, smoke control system, etc.
4. Information should be provided in an electronic version to the extent possible. Legible, scanned images are acceptable for non-electronic documentation to facilitate this deliverable.

3.2 CM at RISK & SUBCONTRACTOR'S RESPONSIBILITIES

A. Perform commissioning tests at the direction of the CxA.

B. Attend construction phase controls coordination meetings.

C. Participate in life safety and security systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.

D. Provide information requested by the CxA for final commissioning documentation.

E. Include requirements for submittal data, operation and maintenance data, and training in each purchase order or sub-contract written.

F. Prepare preliminary schedule for life safety systems' and security systems' orientations and inspections, operation and maintenance manual submissions, training sessions, equipment start-up and task completion for owner. Distribute preliminary schedule to the CM at Risk and the CxA.

G. Update schedule as required throughout the construction period.

H. During the startup and initial checkout process, execute the related portions of the verification checklists for all commissioned equipment.

I. Assist the CxA with all verification and functional performance tests.

J. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

K. Gather operation and maintenance literature on all equipment, and assemble in binders as required by the specifications. Submit to the A/ E and the CxA within 45 days after submittal acceptance.

L. Coordinate with the CxA to provide 48-hour advance notice so that the witnessing of equipment and system start-up and testing can begin.

M. Notify the CxA and the A/E a minimum of two weeks in advance of the time for start of the testing and balancing work. Attend the initial testing and balancing meeting for review of the official testing and balancing procedures.

N. Participate in, and schedule vendors and contractors to participate in the training sessions.

O. Provide written notification to the CxA and the A/E that the following work has been completed in accordance with the contract documents, and that the equipment, systems, and sub-system are operating as required.

1. Fire detection and alarm systems, including smoke detectors, heat detectors, pull stations, alarm indication devices (horns, speakers, and strobes), water flow switches and firefighters' phone system
2. Smoke control system, including exhaust fans, supply (pressurization) fans, door releases, elevator override testing and system testing under emergency power.
3. Security systems, including access control and video surveillance systems.

P. The equipment supplier shall document the performance of his equipment.

Q. Provide a complete set of red-lined drawings to the CxA and the A/E prior to the start of Functional Performance Testing.

R. Provide training of the Owner's operating staff using expert qualified personnel, as specified.

S. Equipment Suppliers

1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner, to keep warranties in force.
2. Assist in equipment testing per agreements with contractors.
3. Provide information requested by CxA regarding equipment sequence of operation and testing procedures.

T. Refer to Division 01 Section 01 91 13 "General Commissioning Requirements" for additional Contractor responsibilities.

3.3 OWNER'S RESPONSIBILITIES

A. Refer to Division 01 Section 01 91 13 "General Commissioning Requirements" for Owner's Responsibilities.

3.4 DESIGN PROFESSIONAL'S RESPONSIBILITIES

A. Refer to Division 01 Section 01 91 13 "General Commissioning Requirements" for Design Professional's Responsibilities.

3.5 Cx AUTHORITY'S RESPONSIBILITIES

A. Refer to Division 01 Section 01 91 13 "General Commissioning Requirements" for CxA's Responsibilities.

3.6 TESTING PREPARATION

A. Certify in writing to the A / E and the CxA that life safety systems and security systems, including subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Certify in writing that testing procedures have been completed and that testing reports have been submitted, discrepancies corrected, and corrective work approved.

C. Place systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

D. Inspect and verify the position of each device and interlock identified on checklists.

E. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

F. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.7 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

B. Scope of life safety system and security system testing shall include the entire fire detection and alarm system(s), the entire smoke control systems(s), the entire physical access control system(s), the entire intrusion detection system(s), and the entire video surveillance system(s). Testing shall include evaluating and verifying the effectiveness of all operational, monitoring and control functions.

C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

D. The CxA, along with the CM at Risk, and the various life safety and security subcontractors, including the fire detection and alarm, security and BAS controls subcontractors, shall prepare detailed testing plans, procedures, and checklists for the life safety and security systems, subsystems, and equipment.

E. Tests will be performed using design conditions whenever possible.

F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

G. The CxA may direct that set points be altered when simulating conditions is not practical.

H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

I. If tests cannot be completed because of a deficiency outside the scope of the life safety and security systems, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

3.8 ELECTRICAL SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

A. Equipment Testing and Acceptance Procedures: Testing requirements are specified in individual Division 26, Division 27 and Division 28 technical sections. Provide submittals, test data, inspector record, and certifications to the CxA.

B. Life Safety and Security Systems' Testing: Field testing plans and testing requirements are specified in technical sections of these specifications. Assist the CxA with preparation of testing plans.

C. The work included in the commissioning process involves a complete and thorough evaluation of the operation and performance of all components, systems and sub-systems. The following equipment and systems shall be evaluated:

1. Automatic temperature controls integrated with the life safety and security systems
2. Coordination and functionality with the Building Automation System / DDC Controls System integrated with the life safety and security systems
3. Fire Detection and Alarm System – all devices
4. Smoke Control System
5. Stair Pressurization System
6. Elevator Recall and Override Operation
7. Security – Physical access control systems
8. Security - Video surveillance systems
9. Security – Intrusion detection systems
10. Security systems integration and alarm call-up

3.9 DEFICIENCIES/NON-CONFORMANCE, COST OF RETESTING, FAILURE DUE TO MANUFACTURER DEFECT

A. Refer to Division 01 Section 01 91 13 "General Commissioning Requirements" for requirements pertaining to deficiencies/non-conformance, cost of retesting, or failure due to manufacturer defect.

3.10 APPROVAL

A. Refer to Division 01 Section 01 91 13 "General Commissioning Requirements" for approval procedures.

3.11 DEFERRED TESTING

A. Refer to Division 01 Section 01 91 13 “General Commissioning Requirements” for requirements pertaining to deferred testing.

3.12 OPERATION AND MAINTENANCE MANUALS

A. The Operation and Maintenance Manuals shall conform to Contract Documents requirements as stated in Division 01.

B. Refer to Division 01 Section 01 91 13 “General Commissioning Requirements” for the A/E and CxA roles in the Operation and Maintenance Manual contribution, review and approval process.

3.13 TRAINING OF OWNER PERSONNEL

A. Refer to Division 01 Section 01 91 13 “General Commissioning Requirements” for requirements pertaining to training. All training shall be videotaped for future use.

B. Life Safety System and Security System Contractors. Shall have the following training responsibilities:

1. Provide the CM at Risk with a training plan for review by the CxA, the A/E, and the OR a minimum of two (2) weeks before the planned training.
2. Provide designated Owner personnel with comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of commissioned life safety and security system equipment.
3. Training shall start with classroom sessions, if necessary, followed by hands on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.
4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
5. The appropriate trade or certified factory manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer’s representative. Practical building operating expertise, as well as in-depth knowledge of all modes of operation of the specific piece of equipment, is required. More than one party may be required to execute the training.
6. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.
7. Training shall include:
    a. Use the printed installation, operation and maintenance instruction material included in the O&M manuals.
    b. Include a review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.

c. Discuss relevant safety issues and concerns.
d. Discuss warranties and guarantees.
e. Cover common troubleshooting problems and solutions.
f. Explain information included in the O&M manuals and the location of all plans and manuals in the facility.
g. Discuss any peculiarities of equipment installation or operation.

8. Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and preventative maintenance of all pieces of equipment.
9. The life safety system and security system contractors shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central control system.
10. Training shall occur after functional testing is complete, unless approved otherwise by the Owner's.

END OF SECTION 28 08 00

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SECTION 28 13 00 - PHYSICAL ACCESS CONTROL SYSTEM

END OF SECTION 28 13 00

SECTION 28 16 00 - INTRUSION DETECTION SYSTEM

END OF SECTION 28 16 00

SECTION 28 23 00 - VIDEO SURVEILLANCE SYSTEM

END OF SECTION 28 23 00

SECTION 28 31 00 - ADDRESSABLE FIRE DETECTION AND ALARM

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.

B. Related Specification Sections:

1. Refer to Specification Section 27 05 00 for requirements

1.2 SUMMARY

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

B. This section provides requirements for the installation and configuration of an extension of the existing fire alarm system location in the APM/ ITF South Terminal Complex (STC)

1.3 SCOPE OF WORK

A. Refer to Specification Section 27 05 00 and 28 05 00 in addition to the following.

B. Refer to drawing sheet FA0.00.03 for the work responsibility matrix for the scope of work required for the system and for any work provided by the Authority.

C. Where listed on the drawing responsibility matrix, the following components shall be defined as follows.

1. Headend and Software: Contractor shall furnish, install, and program all required headend equipment and software including, but not limited to licensing, system expansion, redundancy, workstation licenses, operating software license or any other software required to expand the existing system to support all new elements added under this contract. Contractor shall be required to coordinate requirements as well as scheduling license installation. Headend and software include any panels, cabinets, management/administrative software, software licenses, programming, and components which serve the purpose of performing system-wide coordination, monitoring, data processing, control and other global functions.
2. Integration to Existing System: Energizing and connecting of new or modified system components to the existing fire detection and alarm system shall be performed by the Authority's current Testing, Certification and Repair (TC&R) Contractor. The TC&R Contractor shall perform all necessary testing to certify the system extension/modification and perform the necessary programming changes required for a complete operating system. The work performed by the TC&R contractor is part of the contract and shall be included in the bid price and fully coordinated by the contractor.
   a. The Authority's current TC&R Contractor is Commercial Systems Group, 151 Semoran Commerce Place, Apopka, FL 32703, P 407/814-0225, F 407/814-8868, C 321-228-1626, www.comsysgroup.com.

3. Interfaces: Contractor shall provide all system interfaces. Interfaces include 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.
4. Network Switches: Contractor shall provide a complete FAS as described in this section. For LAN requirements, refer to specification section 27 05 00. Coordinate network programming requirements with GOAA IT for FAS operation on the GOAA network. Contractor shall coordinate patching into the network with GOAA.
5. Backbone Cable: Refer to specification section 27 10 00 for requirements. Coordinate system backbone requirements with backbone cable Contractor.
6. Horizontal Cable: Contractor shall provide dedicated FAS signal cabling as described in this section.
7. Field Devices: Contractor shall provide all field devices including, but not limited to power supplies, initiating devices, notification appliances, indicators, speakers, auxiliary devices, and similar equipment or appliances.

1.4 DESCRIPTION

A. Provide all labor, materials, equipment, and services necessary and required to provide, install and test a complete extension of existing automatic fire detection and alarm system to comply with these specifications and all regulatory requirements.

B. Provide a complete extension of existing fire alarm detection system. The system shall include but not be limited to all control panel components, power supplies, batteries, signal initiating devices, notification devices, wire, fittings, accessories, programming, software licenses, and interfaces to other systems required to provide a complete operating system.

C. The Fire Alarm system shall interface with the ECS system to provide voice annunciation for the fire alarm system. Fire alarm shall interface with the ECS system to provide the following functionality:

1. Supervision of ECS system fault and supervisory conditions at all active components. Additionally, faults in ECS system shall be display on fireworks GUI in actual location of equipment (by comm. Room and cabinet designation where equipment is located)
2. Notification zone control of ECS system via supervised contact closure input to ECS. One input for each notification zone minimum. Additional inputs/outputs shall be use for proper system interface.
3. FA system shall distribute line level audio to ECS for notification to all building areas. All fire alarm messages shall be generated at local building FACP and shall feed into local building ECS ACS controller.

D. The contractor shall coordinate withal other systems required to provide a complete and operational system. These shall include but not be limited to the following:

1.5 SOUTH TERMINAL COMPLEX

A. Existing system is an EST3 Network system which located in the APM/ITFG Main communications room. STC system reports to the North Terminal Complex (NTC) Comm Center fireworks workstation.

B. All initiating devices shall be addressable. Control shall be microprocessor based and field-programmable node. All electronics shall be solid state. All notification devices shall match the existing system.

C. System to be a zoned, non-coded, closed circuit supervised fire alarm system. The entire fire alarm system shall be continuously electrically supervised against interruption or failure of the initiation and notification circuits including switches and electrical contacts. Detect opens, shorts, and grounds in the system.

D. Coordinate with other Work to assure completeness of system including but not limited to: conduit, raceways, outlet boxes, wire, cable, supports, surge suppression, junction boxes, pull boxes, identification, enclosures, cabinets, and grounding.

E. Provide all required control and interlock wiring between fire alarm system and building equipment. Controls are required to/for/from: fire/smoke air and duct detectors, fire/smoke dampers and smoke dampers, supply/return and exhaust fans, smoke evacuation equipment, automatic fire extinguishing systems, sprinkler and fire system water sprinkler system components, etc. (as applicable to Work).

F. No additions, modifications or alterations to an existing fire alarm system shall proceed prior to appropriate notification of the OAR and GOAA’s Maintenance Department Life Safety Division. Notifications shall be made via the TC&R Contractor. Maintenance Department Electronic shop shall be notified prior to returning fire alarm system back to service and shall have a representative present.

G. The Contractor shall provide and install the Fire Alarm system (including all equipment, wiring, etc.) in accordance with the manufacturer's recommendations.

1. Installation of devices shall be in accordance with the manufacturer's requirements as well as the requirements of the contract Documents. Recommendations by the manufacturer for the proper installation of the Fire Alarm system and its equipment shall not preclude the requirements for the Contractor to comply with the requirements of the contract Documents.
2. Termination of Fire Alarm circuits shall be in accordance with the manufacturer's recommendations, applicable requirements of the National Electric Code (NFPA 70), ADA, other applicable Codes and the Contract Documents.
3. Voice evacuation audio shall be provided thru the Emergency communications System (ECS) refer ECS drawings and specs for additional information.

4. The Fire Alarm installer shall be responsible for ensuring that prior to bidding the project the Electrical Contractor understands the raceway requirements for the project. Claims by the Contractor after award of the project in regard to additional raceway required either by the fire Alarm System Manufacturer's recommendations for proper installation of the system and its associated equipment, or for compliance with the requirements of the Contract Documents, shall not be allowed.

H. The Contractor is advised that circuit routing for this system is not necessarily shown on the project drawings. The Contractor shall provide and install all raceways, wiring and cabling required for a complete and fully functional system as intended by these specifications. All wiring and/or cabling shall be in conduit. Contractor shall provide and install a properly sized, flush mounted outlet box for every device. Contractor shall size and route raceways to accommodate the proper installation of the system cabling. T-Tapped cabling shall not be acceptable. In locations where raceway and/or conduit is not accessible after completion of the project, conduit shall be routed from device to device or fire rated access panels shall be installed to provide access to junction and pull boxes. Routing of raceway from device to device shall only be acceptable where the wiring scheme of the system, as recommended by the manufacturer, requires cable to pass from device to device. Contractor shall properly terminate each device according to the manufacturer’s recommendations. Provide and install firestopping where penetrations are made through rated walls and floors.

I. All fire alarm cabling shall be in raceway.

J. The Fire Alarm System shall be tested, by the Contractor, in the presence of the City of Orlando Fire Department, upon permanent installation of the equipment in the new Communication Center and prior to acceptance by the Owner. This testing shall be in addition to any other testing required by these project documents. The Contractor shall be responsible for including all costs for this testing within his bid. The testing procedure shall include in-depth testing of all portions of the system that have been moved, modified or worked in as part of this project. In addition, this testing shall, as a minimum, involve random testing of devices at the discretion of the Orlando Fire Department.

K. The Contractor shall be responsible for providing personnel necessary to accomplish either a fire watch and/or a security watch in unprotected areas during times when the fire alarm system is off-line.

1. Where the fire alarm system is inactive in any area due to the work of this project the Contractor shall, as a minimum, provide personnel necessary to observe the status of each fire alarm control panel in the affected area.

2. When security functions provided by the fire alarm system are off-line in any area or partial area the Contractor shall, as a minimum, provide one person at each AOA door until the system is operational. During those times where the off-line time is planned the Contractor shall station personnel fifteen (15) minutes prior to the commencement of off-line operations. During those times where the off-line time is accidental the Contractor shall station personnel within five (5) minutes of the system going off-line.

L. The Contractor shall furnish and install all equipment (raceways, wire/cable, circuit breakers, modules, relays, etc.) necessary, and as required by applicable code to, to accomplish incidental functions of the fire alarm system including but not limited to the following:

1. HVAC system control and/or shutdown.
2. Ventilation system (supply fans, exhaust fans, fan terminal boxes, etc.) control and/or shutdown.
3. Smoke Control system control and/or shutdown.
4. Control of fire, smoke, and/or combination fire/smoke dampers.
5. Monitoring of fire suppression and or extinguishing systems (Inergen System, Halon System).
6. Control of fire and/or smoke doors, dampers, shutters, etc.
7. escalator shut down
8. gas/fuel
9. elevators
10. access control on egress doors
11. Override of third party and tenant / vendor systems per NFPA.
12. Interface with ECS system for voice notification and supervision.
13. Updating to the existing Firework Workstation GUI to indicate additional buildings and devices. Including all programming, equipment, firmware, licenses, etc required.

M. The fire alarm system shall not share a raceway, junction box, enclosure, manhole or device with any other system.

N. Although they may not be indicated on the Fire Alarm system diagram and/or drawings, all required control and interlock wiring between the Fire Alarm system and building equipment shall be provided hereunder, Controls are required to/for/from:

1. Fire/smoke air and duct detectors
2. Fire, smoke and/or combination fire/smoke dampers.
3. Supply/Return fans, Exhaust fans, and/or Fan Terminal Boxes (FTB)
4. Automatic fire extinguishing systems
5. Smoke evacuation equipment
6. Sprinkler and/or Fire Protection system components

O. Provide and install all relays (electric-electric, electric-pneumatic, and/or pneumatic-electric) as required for a complete and operational fire alarm system, complying with all applicable codes and all requirements, and coordinated with all divisions of these specifications.

P. Zoning

1. Alarm Zones.
   a. Regardless of the number of zones shown on drawings, the minimum alarm zones required are:
      1) One per 3000 square feet per floor, for pull stations and heat detectors.
      2) One per 3000 square feet per floor, for smoke detectors.
      3) One for each duct smoke detector.
2. Notification Zones.
   a. Regardless of the number of zones shown on drawings the minimum notification zones (horns and strobe lights) required are:
      1) One per floor. Breakdown circuits as required for load and distances involved.

1.6 SYSTEM OPERATION

A. System operation shall meet the operation requirements of all codes and regulatory requirements.

B. The system shall provide, as a minimum, the same operation and functions of the existing system, plus all new functions as specified.

C. Refer to Life safety / Mechanical plans and specs for all smoke control related sequence of operation.

D. Upon activation of the Fire Alarm System by a manual station the following shall take place:

1. Energize all alarm signaling devices.
2. Sound all audible alarms and flash visual signals throughout the building.
3. Alert local fire department or proprietary system.
4. Cause alarm to be displayed on the annunciator section of the control panel.
5. Close all doors, held open by automatic release devices throughout the facility, or by zone (coordinate with architect and door hardware supplier, provide all electrical required).
6. Unlock all electrically locked doors (coordinate with architect and door hardware supplier, provide all electrical required).

E. Upon activation of the Fire Alarm System by any smoke detector, any sprinkler flow alarm switch or other automatic detection device, the following shall take place in addition to the above:

1. Shut down all air handlers and exhaust fans supplying or exhausting air in at least the zone where the alarm is initiated.
2. Shut all smoke dampers in ducts associated with the air handling units and exhaust fans which are shut down, in at least the zone where the alarm is initiated. (Coordinate with mechanical and provide all electrical as required).
3. Transmit signals to building elevator control panel to initiate return to main floor or alternate floor.
4. Transmit signals to building automation system to tell system that the fire alarm system has taken control of respective mechanical system.

5. Send a signal to all dimming and lighting relay/control systems. Fire alarm signal shall initiate dimming system controls to drive all dimmed circuits to immediate full-on output. Fire alarm signal shall initiate lighting relay/control system to turn on all emergency lighting circuits.
6. Send a signal to all non-fire alarm sound reinforcement systems. Fire alarm signals shall override all other sound systems. Alarm notification signals shall take precedence over all other signals. Operation of other sound systems shall resume after fire alarm system clears alarm.

F. Elevator: Smoke detectors associated with elevator lobbies and machine rooms shall be types approved by the Florida State Fire Marshall under F.A.C. Chapter 4A-47 Uniform Fire Safety Standards for Elevators. Elevator recall shall be initiated ONLY by elevator lobby and machine room smoke detectors. In addition to those functions outlined in "A" above, elevator detector(s) shall initiate the following functions.

1. The operation of any one Elevator Lobby Product of Combustion Detectors associated with a single bank of elevators shall signal the elevator controls to commence required procedures for that bank of elevators. Refer to Division 14 for required procedures, floor(s) of recall, and alternate floor(s) of recall.
2. The operation of any elevator machine room Product of Combustion Detector that is part of this Fire Alarm System shall signal the elevator controls to commence required procedures for that bank of elevators. Refer to Division 14 for required procedures.
3. The activation of the smoke detector(s) in a machine room shall cause a suitable warning light to flash. The light is to be located adjacent to the "Phase One" recall switch or elevator hall button at the designated and alternate fire department access level.
4. Fire alarm system shall monitor shunt trip voltage per NFPA 72.

G. System supervisory faults, such as shorts, opens, and grounds in conductors, operating power failure, or faults within supervised devices, shall place the system in the trouble mode, which causes the following system operations:

1. Visual and audible trouble signal indicated be zone at the fire alarm control panel.
2. Visual and audible trouble signal indicated at remote annunciator panel.

H. Manual acknowledgement function at fire alarm control panel shall silence audible trouble signal; visual signal shall be displayed until initiating failure or circuit trouble is cleared.

I. Alarm Reset: The system shall remain in the alarm mode until manually reset with a key accessible reset function. The system shall reset only if the initiating circuits are cleared.

J. Lamp Test: manual lamp test function causes alarm indication at each lamp on the fire alarm control panel and the remote annunciator.

K. When the fire alarm system is activated as a drill, all incidental functions shall be exercised including notification of the fire department.

L. Where required by codes or authority having jurisdiction:

1. When system is silenced by silence switch in control panel, audible alarm is to silence but visual alarm devices are to continue to operate.
2. The fire sprinkler valve tamper switch, when closed, shall annunciate a supervision signal at the fire alarm control panel and annunciator panels, if any. This supervision signal shall not cause a general alarm.
3. Operation of auxiliary contacts in control panel to shut all smoke dampers in ducts associated with air handling units and exhaust fans which are shut down. (These shall not be controlled from detector unit contacts.)

1.7 SUBMITTALS

A. Submit in accordance with Section 28 05 00 Common Work Results for ESS and Section 01 33 23 Shop Drawings, Product Data, and Samples.

B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: Documentation for Low Emitting Materials
   a. Low Emitting Materials for Adhesives and Sealants

1.8 PROJECT RECORD DOCUMENTS

A. Submit in accordance with Section 28 05 00 Common Work Results for ESS and Section 01 78 00 Closeout Submittals.

1.9 O & M MANUALS

A. Submit in accordance with Section 28 05 00 Common Work Results for ESS and Section 01 78 00 Closeout Submittals.

1.10 QUALITY ASSURANCE

A. Refer to Specification Section 28 05 00 in addition to the following.

B. Manufacturer: Company specializing in manufacturing the products specified with minimum ten (10) years experience and with service facilities within 50 miles of Project.

C. Installer:

1. Company specializing in installing the products specified with minimum ten (10) years experience and certified by the State of Florida as fire alarm installer.
2. The installing Contractor shall be a direct sales division of, or the authorized and designated distributor for, the fire alarm system manufacturer.
3. Installing Contractor shall maintain a local staff of specialists, including a Fire Alarm Planning Superintendent, for planning, installation, and service.

4. The installing Contractor shall be capable to provide emergency service 7-days-a-week, 24 hours a day. The installing Contractor shall have been actively engaged in the business of selling, installing and servicing fire alarm systems for at least five consecutive years from date of bid opening.

1.11 ADDITIONAL DEVICES FOR JURISDICTIONAL COMPLIANCE

A. Prior to bid, Contractor shall review plans and specifications carefully for compliance with all codes, and in particular the ADA requirements and NFPA 72. Contractor shall include in bid price any devices required to provide a fully compliant system. Said additional devices shall be shown on shop drawings submitted by Contractor.

B. In addition to the above-mentioned devices, Contractor shall include in his bid price the cost of installing 50 additional audible/visual notification devices (over and above those shown on drawings, required by specifications, or determined by system installed to be required) whose location/need may not become apparent until just prior substantial completion date. At least two weeks prior to substantial completion system shall be fully operational. After system is operational GOAA OAR, EOR and the system installer shall review the placement of and coverage provided by visual and audible signals throughout the facility for compliance with all codes and in particular, the ADA requirements and NFPA 72. System installer shall provide the additional devices at locations where the Architect/Engineer requests for complete coverage. The additional devices shall be installed and fully operational prior to date of Substantial Completion.

C. After the project has had its first annual safety inspection, the system installer shall install within one week notice any additional audible/visual signals that have been determined to be required during said inspection from the balance of the additional devices noted above. There shall be no cost for these added devices provided the total does not exceed the balance remaining of the devices noted above. The final balance of the additional devices included in bid price shall be turned over to the Owner as spare material after any fire alarm issues identified during the first annual safety inspection are resolved.

1.12 OWNER'S INSTRUCTION:

A. Refer to Specification Section 28 05 00 in addition to the following.

B. Provide instruction to the Owner's designated personnel upon completion of the system installation. Instruction shall include a functional training session on fire alarm control panel operation and on peripheral device operation, including what are normal indications and alarm indications of each type of new/added device.

1. Videotape all training sessions and deliver (4) copies of tapes to Owner's Authorized Representative (for use in future training).

1.13 EQUIPMENT WARRANTY

A. Refer to Specification Section 28 05 00 in addition to the following.

B. Warrant all equipment to be new and free from defects in material and workmanship, and will, within one year from date of acceptance by GOAA, repair or replace any equipment found to be defective.

1. No charges shall be made by the installer for any labor, equipment or transportation during this period to maintain functions.
2. Respond to service call within twenty-four (24) hours after receipt of such a call.

1.14 REFERENCES AND REGULATORY REQUIREMENTS

A. Refer to Specification Section 28 05 00 in addition to the following.

B. The equipment and installation shall comply with, but not be limited to the current or applicable provisions of the following:

1. National Electric Code, Article 760.
2. National Fire Protection Association Standards:
   a. NFPA 70 - National Electrical Code.
   b. NFPA 72 - Application, performance, installation and maintenance of fire alarm systems and their components.
   c. NFPA 101 - Life Safety Code.
   d. NFPA 90A: Air Conditioning and Ventilating Systems.
3. Underwriters Laboratories Inc. The system and all components shall be listed by Underwriters Laboratories Inc. for use in fire protective signaling system under the following standards as applicable:
   a. UL 864/UOJZ: APOU Control Units for Fire Protective Signaling Systems.
   b. UL 268: Smoke Detectors for Fire Protective Signaling Systems.
   c. UL 268A: Smoke Detectors for Duct Applications.
   d. UL 521: Heat Detectors for Fire Protective Signaling Systems.
   e. UL 464: Audible Signaling Appliances.
   f. UL 1638: Visual Signaling Appliances.
   g. UL 1481: Power Supplies for Fire Protective Signaling Systems.
   h. UL 1480: Speakers.
   i. UL 1424: Cables.
   j. UL 1971: Signaling Devices for the Hearing Impaired.
   k. UL 228: Door holders for Fire Protective Signaling Systems.
   l. UL 38: Manually activated signaling boxes.
   m. UL 1711: Amplifiers for Fire Protective Signaling Systems.
4. Florida Building Code: Latest adopted edition.
5. Florida Administrative Code. All applicable chapters including but not limited to:
   a. Chapter 4A Rules, including but not limited to:
      1) Ch 4A-48 Fire Safety Standards for the Fire Alarm Systems.
      2) Ch 4A-46 Fire Protection System Contractors and Systems.
      3) Ch. 4A-3 Fire Prevention - General Provisions.
   b. Florida Department of Insurance:

1) Insurance Code: The fire alarm system and installation thereof shall comply with the State of Florida Department of Insurance rules. The requirements of the Florida State Department of Insurance shall be as promulgated by the Division of State Fire Marshal.
2) Fire Alarm Rules: The fire alarm system and installation thereof shall comply with the Fire Safety Rules promulgated by the Florida State Fire Marshal.

6. Federal Register - Rules and Regulations - Non-discrimination on the basis of Disability by Public Accommodations and in Commercial Facilities.
7. Americans with Disabilities Act (ADA): The fire alarm system shall comply with ADA, Public Law 101-336, 1990. The system shall comply with ADA Accessibility Guidelines (ADAAG).
8. Department of Community Affairs Florida Board of Building Codes and Standards - Accessibility Requirements Manual.
9. General: The system shall comply with all applicable Codes, Ordinances and Standards as interpreted and enforced by the local authority having jurisdiction.
10. State of Florida: Division of State Fire Marshal.

C. Each item of the fire alarm system shall be listed and classified by UL and FM as suitable for purpose specified and indicated.

D. All Control Equipment shall be listed under UL category UOJZ.

E. The system controls shall be UL listed for Power Limited Applications per NEC 760. All circuits must be marked in accordance with NEC article 760-23.

F. IEEE: The fire alarm system includes solid state electronic components. Therefore, the equipment manufacturer shall provide certification that all such equipment is internally protected from, or can withstand, power line surge voltages and currents as specified in Table 1, Location Category a High Exposure of ANSI/IEEE Standard C62.41-1980 (formerly IEEE Standard 587).

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide all equipment necessary for a complete extension of existing Fire Alarm system.

B. All equipment shall be new and UL listed for intended fire alarm purposes.

C. Provide all equipment to match existing equipment required to perform all functions and features even though not specifically noted or specified herein.

D. See drawings for description of devices.

E. Match existing equipment.

1. Existing system in the STC APM/ITF is EST/EDWARDS SYSTEMS TECHNOLOGY. Equipment added to the system shall be EST-3 or latest "Signature" series.

F. All devices (except beam detectors) shall be addressable type.

G. Provide back box as recommended by system manufacturer for all devices.

~~G.~~H. Provide manufacture statements that confirm that the adhesive products used meets the California Department of Public Health (CDPH) Standard Method v1.1 2010 using the applicable exposure scenario

2.2 FIRE FIGHTER CONTROL PANEL (FFCP)

A. Located in Fire Command Room, and shall provide graphical layout indicating all Smoke Exhaust and Pressurization related equipment.

1. System shall be complete with PC workstation and associated components (mouse, keyboard, speakers, 32" desktop monitor, etc)
2. Provide 60" LCD monitor on wall as indicated in drawings and connect to mirror desktop monitor display. All monitors shall have a minimum resolution of 1920x1080P.
3. Provide complete Fireworks software suite on workstations in ASC and LST fire command rooms. Systems shall be configured to operate the complete STC system in each location.

B. Panel shall provide both positive indication of system and device status and manual control over all points in the systems per NFPA 92 and 72.

C. Include indication of each LS UPS (status) connected to FA/ECS system operations.

D. Refer to details in drawings for additional layout information.

E. Basis of Design: EST3 Fireworks

2.3 FIRE ALARM CONTROL PANEL (FACP)

A. FACP shall consist of a full height cabinet capable of supporting (3) chassis assemblies with the capability of seven local rail module spaces each. Provide with inner and outer door.

B. Shall be equipped with CPU and LCDXL display modules.

C. Provide all fiber optic communications cards as required to connect to existing EST fire alarm network.

2.4 POWER SUPPLY

1. The power supply for the panel and all peripheral fire alarm devices shall be integral to the control panel. The power supply shall provide all control panel and peripheral power needs as well as 3.0 amperes of unregulated 24 VDC power for external audio-visual devices. The audio-visual power may be increased as needed by adding additional modular expansion power supplies (NAC expander). All power supplies shall be designed to meet UL and NFPA requirements for power-limited operation on all external signaling lines, including initiating circuits and indicating circuits.
2. All power supplies shall be provided by the same manufacturer as the fire alarm control panel (FACP). Power supplies provided by manufacturers other than the manufacturer of the fire alarm control panel (FACP) shall not be acceptable.
3. Circuit breakers or other over-current protection on all power outputs.
4. Input power shall be 120 VAC, 60 Hz. The power supply shall provide internal batteries and charger. Internal battery capacity shall be as required.
5. The battery pack shall provide 24 hours maximum normal operating and supervisory power and, at the end of that required period of time, provide 15 minutes power to operate all alarm signals as required by NFPA 72.
6. Increase quantities/sizes of all expansion power supplies, batteries, circuits, etc., as necessary to meet NFPA 72 requirements for circuit loading, voltage drops, etc.

2.5 FIRE ALARM TERMINAL CABINET (FATC)

A. Remote Closet Cabinets are surface mounted and come in sizes providing space three chassis, with room for standby batteries.

B. Remote Closet Cabinets have left hand hinged doors and are available with red finish only.

C. RCC cabinets can also be used as remote battery cabinets.

D. Provide all required mounting hardware and terminal strips to support all cabling and devices being installed in terminal cabinet.

E. Provide terminal strips for all field cable.

F. Manufacturer: EST3 #3-CAB21

2.6 BOOSTER POWER SUPPLY (BPS)

A. Supply, where needed or as indicated on drawings, Booster Power Supplies (BPS) that are interconnected to and supervised by the main system.

B. The BPS shall function as a stand-alone auxiliary power supply with its own fully-supervised battery compliment.

C. The BPS battery compliment shall be sized to match the requirements of the main system and be capable of mounting addressable relay for control and interface.

D. The EBPS shall be capable of supervising and charging batteries having the capacity of 24 ampere-hours for Mass Notification/Emergency Communication (MNEC), life safety and security applications, and the capacity of 65 ampere-hours for access control applications.

E. The BPS shall provide a minimum of four independent, fully supervised Class B circuits that can be field configurable for notification appliance circuits or auxiliary 24 Vdc power circuits. BPS NACs shall be convertible to a minimum of two Class A NACs.

F. Each BPS output circuit shall be rated at 3 amperes at 24 Vdc. Each output circuit shall be provided with automatically restoring over current protection.

G. The BPS shall be operable from the main system NAC and/or Edwards Signature Series control modules.

H. Fault conditions on the BPS shall not impede operation of main system NAC. The EBPS shall be provided with ground fault detection circuitry and a separate AC fail relay.

I. Provide Sync Module in BPS for all local NAC circuits.

J. Manufacture: EST3 #EBPS10A

2.7 INITIATING DEVICES (ADDRESSABLE)

A. Manual Station: Surface mounted non-coded type, double action manual station, non break-glass type. Reset key to match existing pull station key/lock.

1. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure, hinged at the top to permit lifting for access to initiate an alarm. Provide where device is exposed to the elements

B. Spot Heat Detector: Fixed temperature, or combination rate-of-rise and fixed temperature, rated 135 degrees F (57 degrees C), and temperature rate of rise of 15 degrees F (8.3 degrees C).

C. Ceiling Mounted Smoke Detector: NFPA 72, photoelectric type with adjustable sensitivity, plug-in base, auxiliary relay contact (where required), and visual indication of detector actuation, suitable for mounting on 4-inch (102 mm) outlet box.

D. Duct Mounted Smoke Detector: NFPA 72, photoelectric type with auxiliary SPDT relay contact (where required), key-operated NORMAL-RESET-TEST switch, duct sampling tubes extending width of duct, and visual indication of detector actuation, in duct-mounted housing.

E. Beam-Type Smoke Detector (BEAM): NFPA 72, use in LST. Each detector consists of a separate transmitter and receiver with the following features:

1. The projected beam type smoke detector shall be listed to U.L. 268 and shall consist of up to two integrated transmitter, receiver detector heads and single low level remote control unit.

2. The detector shall operate between a range of 26.2 ft to 328 ft (8 m to 100 m).
3. The temperature range of the system shall be -4°F to 131°F (-20°C to 55°C).
4. The beam detector heads shall include an integral built-in laser pointer to assist prism mounting. The beam detector shall feature automatic gain control which will compensate for gradual signal deterioration from dirt accumulation on the lenses and prisms.
5. The beams detector heads shall include AutoOptimise self-correcting motorized head feature to ensure unit is always receiving maximum signal available, and shall automatically compensate for building shift.
6. The unit shall include a low level remote display and control unit with LCD read-out for set-up, reporting and testing of up to 2 separate detector heads.
7. The System shall have separate Trouble and Alarm relays for each of the 2 channels.
8. Manufacturer: Fireray #5000

F. Open-area Smoke Imaging Detector (OSID): NFPA 72, use in ASC HUB. Each detector consists of a multiple emitters and receiver with the following features:

1. Dual wavelength LED-based smoke detection
2. Optical imaging with CMOS imaging chip
3. On-board event log for fault and alarm diagnostics
4. Simple DIP switch configuration
5. Three selectable alarm thresholds
6. Status LEDs for Fire, Trouble and Power
7. Conventional alarm interface for straightforward fire system integration
8. Provide remote test and reset station in accessible area for each receiver
9. Provide emitters and receivers where indicated on plans
10. All components shall be hardwired and power via local BPS
11. Provide light shields for receivers
12. Manufacture: Xtralis OSI-90

G. Air Sampling Smoke Detector (AS): NFPA 72, each detector consists of air sampling heads, trunk and branch piping, and remote controller unit with the following features:

1. Flair detection technology delivers reliable very early warning in a wide range of environments with minimal nuisance alarms
2. Multi stage filtration and optical protection with clean air barriers ensures lifetime detection performance
3. Four alarm levels and an ultra wide sensitivity range deliver optimum protection for the widest range of applications
4. Intuitive LCD icon display provides instant status information for immediate response
5. Flow fault thresholds per port accommodate varying airflow conditions
6. Smart on-board filter retains dust count and remaining filter life for predictable maintenance
7. Extensive event log (20,000 events) for event analysis and system diagnostics
8. Auto Learn™ smoke and flow for reliable and rapid commissioning
9. Referencing to accommodate external environmental conditions to minimize nuisance alarms
10. Fully backward compatible with VLP and VESDAnet

11. Remote monitoring with iVESDA for system review and proactive maintenance
12. Ethernet for connectivity with Xtralis software for configuration, secondary monitoring and maintenance
13. Industry first. Aspirating detector secondary monitoring and maintenance via WiFi
14. USB for PC configuration, and firmware upgrade using a memory stick
15. Two programmable GPIs (1 monitored) for flexible remote control
16. Field replaceable sub-assemblies enable faster service and maximum uptime
17. Control Software: Contractor shall provide and configure manufactures test and supervision software for all air sampling panels. All panels shall be provided with a CAT6 LAN connection to the nearest IDF/MDF room and connected to appropriate V-LAN. Provide computer workstation and software to real time monitor all panels in fire fighter control room and at location determined by GOAA maintenance.
18. Piping: Provide piping per project specification between air sampling heads and controller. Piping shall meet the following minimum requirements:
    a. Comply with manufacture installation instruction and recommendations
    b. Shall be FM Global Approved CPVC Pipe
    c. Shall be sized as required per manufacturer's installation requirements.
    d. Basis of design: FlowGuard Gold - Pipe and Fittings
19. Power Supply: Located at each Air Sampling panel. The VPS-100US consists of three main components:
    a. The mounting enclosure, the transformer and the main circuit board. It uses two backup batteries (supplied separately).
    b. The VPS300US consists of one VPS-100US Power Supply and one VBC-001 Battery Cabinet. Together the two units can hold up to 6 batteries (supplied separately).
    c. Note: The VESDA Power Supply uses sealed acid, 12VDC, 12 Amp/hour batteries. To order, use part number VBT-012 (minimum 2).
    d. Manufacturer: VESDA # VPS300US
20. Manufacturer: VESDA-E #VEU-A10

2.8 NOTIFICATION APPLIANCES

A. General:

1. All notification devices shall be white in color

B. Visual Alarm Devices: Xenon strobe lights with clear or no nominal white polycarbonate lens. Mount lenses on a white faceplate. The word "ALERT" is engraved in minimum 1-inch (25-mm) high letters on the lens. Provide 75 cd minimum per Florida Building Code 11-4.28.3(4).

1. Devices have a minimum light output as required by NFPA and ADA.
2. Devices have a minimum light output as indicated on the Drawings
3. Strobe Leads: Factory connected to screw terminals.
4. Combination devices consist of factory-combined, audible and visual alarm units in a single mounting assembly.
5. Synchronized flash outputs.
6. Comply with UL 1971.

7. Manufacturer: EST3 Genesis Series
   a. Wall Mounted: G1WA Series
   b. Ceiling Mounted: GCWA Series

C. Remote Alarm Indicator: LED type, mounted flush in a single gang wall plate.

1. Connected to indicate the alarm operation of a single detector or other device.
2. Legend: “Alarm.”

D. Horns: Electronic sounder type, operating on 24-V dc, horns produce a sound-pressure level of 90 dB, measured 10 feet (3 m) from the source.

E. Voice/Tone Speakers: Comply with UL 1480.

1. Matching Transformers: Tap range matched to the acoustical environment of the speaker location.
2. High-Range Speaker Units: Rated 2 to 15 W.
3. Low-Range Speaker Units: Rated 1 to 2 W.
4. Speaker Mounting: Flush, Pendant, semi recessed, surface, or surface-mounted bidirectional as indicated.
5. Speaker cone shall be mylar cone type.

2.9 AUXILIARY DEVICES

A. Door Release: Magnetic door holder with integral diodes to reduce buzzing.

B. Power supplies, controllers, modules, relays, housings, etc. as required by system manufacturer to support all devices required for a complete and operational system.

C. Isolation Modules:

1. The Isolator Module (IM) is an addressable device that protects a signaling line circuit (SLC) from a to wire-to-wire short.
2. The module monitors line voltages and opens the data line when a short is detected, isolating the short between the two modules located electrically closest to the short.
3. The loop controller assigns an address to the module.
4. The module uses one detector address on the SLC.
5. Manufacturer: EST3 SIGA-IM

D. Addressable control Modules:

1. Provide Input / Output / relays as required and as shown on details
2. Where installed in motherboards provide appropriate version.
3. Manufacturer: EST3 SIGA Series

E. Addressable Circuit Interface Modules:

1. Addressable Circuit Interface Modules: Arrange to monitor one or more system components that cannot otherwise be equipped for multiplexing communication. Modules transmit identification and status to the FACP using a communication transmitter and receiver with unique identification and capability for status reporting to the FACP. Modules shall be used for monitoring of non-addressable devices such as water flow, valve tamper, non-addressable detectors, and for control of notification appliances and AHU systems.
2. Addressable Circuit Interface Modules shall be capable of mounting in a standard electric outlet box.

F. Control Relays: UL listed SPDT or DPDT 10 amp rated contacts, status LED. Provide metal enclosure w/LED Viewing Port

1. A single relay may be energized from a voltage source of 24 Vdc, 24 Vac, 115 Vac or 230 Vac by wiring to appropriate input terminals.
2. Each relay position contains a red light emitting diode (LED) which indicates the relay coil is energized.
3. Relays may be “snapped apart” from a standard four-module assembly and used independently.
4. Provide dust proof metal enclosure with LED viewing hole for all modules.
5. Manufacturer: EST3 #MR101/C and MR104/C

G. Universal I/O Motherboards: Used in AM-1 and AM-2 control modules, and other areas where required. These shall have the following features:

1. Provide mounting and wiring terminations for up to six Signature Series plug-in UIO (SIGA-“M” series) modules.
2. UIO motherboards slide into a rigid extruded track (included) with mounting pads for convenient mounting into a variety of equipment enclosures.
3. UIO modules plug into the board and are held securely in place with captive machine screws. All field wiring connects to terminal blocks on the motherboard, which permits rapid removal and replacement of modules for troubleshooting.
4. Provides mounting and wiring terminations for up to six UIO modules, and feature a riser #1 input and a riser #2 input bus. Jumpers on riser #1 input, between modules, facilitate sharing a single riser among more than one module. This significantly reduces wiring requirements.
5. Enclosure: Each motherboard whall be provided with MFC-A enclosure
6. Manufacturer: EST3 #UIO6/R

2.10 FIREFIGHTERS' TELEPHONES

A. Firefighters’ Telephone Outlet: Comply with NFPA 72 requirements for two-way telephone communication service. 1/4” phone jack shall be mounted on a single gang stainless steel wall plate.

1. Identification: "Firefighters' Telephone."

PART 3 - EXECUTION

3.1 GENERAL

A. Refer to Specification Section 28 05 00 in addition to the following.

B. All of the work specified in this section shall be included within the scope of the contract. The contractor shall retain the Aviation Authority's TC&R Contractor to perform, at a minimum, the following tasks:

1. Make final connections between new or modified components and the existing fire detection and alarm system.
2. Provide any programming required at the fire alarm control panels, remote panels or fireworks computer. This includes programming in support of outages, planned or unplanned, of the system.
3. Test and certify the completed system in accordance with all regulatory requirements.
4. Update the system as-built drawings, CAD files and bitmaps.

C. Locate, install, and test fire alarm and detection system in accordance with the equipment manufacturer's written instructions, and the latest editions of the NFPA, the National Electrical Contractor's Association publication "Standard of Installation" and all applicable codes referenced in this specification.

D. Modify/rework existing system as required for extension to new devices and/or as required for proper operation of entire system, adding new zone modules, surge suppression, power supply and battery capacity or new devices to meet regulatory requirements.

E. Rework/modify/reprogram existing fire alarm control panel and remote control panels to accept and reflect all changes made by alterations as specified.

F. Modify/update the existing fire alarm as-built (Mylars and blueline) drawings and CADD files to reflect modifications, additions, etc. made by this project. Provide blueline sets of changes for approval and comply with all additional requirements as outlined in specifications.

G. Provide all work required for a complete system including complete system testing and checkout. All components shall be properly mounted and wired. The installation of this system shall comply with the directions and recommendations of authorized factory representatives.

H. Provide wiring, cabling, raceways, and electrical boxes in accordance with manufacturer's written instructions.

I. Components shall be electrically "burned-in" by operating the component at full power for a period as recommended by the manufacturer.

J. Installation shall be done in a neat workmanlike fashion by a firm regularly engaged in Fire Alarm Installation and Service.

K. The installation and inspection of all fire detection and fire alarm devices and systems shall be performed by, or under the direct on-site supervision of, a licensed fire alarm technician or a fire alarm planning superintendent who shall certify the work upon completion of the activity. The certifying licensee shall be present for the final test prior to certification.

L. Installation plans and wiring diagrams shall bear the signature and license number of the licensed Fire Alarm Planning Superintendent, the date of installation and the name, address, and certificate-of-registration number of the registered firm.

M. After completion of the installation of the system, the licensee shall complete a NFPA installation certificate. The installation certificate format shall be furnished by the State Fire Marshal. When an installation certificate form has been completed, legible copies shall be distributed as directed by the State Fire Marshal.

N. After an installation has been complete, affix a Fire Alarm Tag to the control panel. The Fire Alarm Tag is in addition to the installation certificate. Protect the Fire Alarm Tag from vandalism by applying pressure sensitive label; do not use a “tie-on” tag. It shall be as required in the Fire Safety Rules as promulgated by the Florida State Fire Marshal.

O. All components shall be completely wired. System shall be fully operable when main power service has failed and the Emergency Standby Generator has assumed emergency system loads. This shall require that any devices which required 120 volt power shall receive supply from an emergency 120 volt source.

P. Power supplies are to be loaded to a maximum of 75% of their capacity. Provide additional power supplies where required to comply with this maximum loading requirement.

Q. Rework existing fire alarm control panel fiber optic network as required for additional panels. Provide all programming and modules required to interface new fire alarm control panels with the existing system.

R. Provide SLC isolation relays at each FATC. Connect to building SLC loop for local SLC devices. Each local Isolated Circuit shall be routed to allow for a maximum of 50 addressable devices.

S. Systems shall remotely monitor and annunciate on fireworks station status of EPG building generators and power availability of all Life-Safety Branch power UPS systems.

3.2 RACEWAYS AND BOXES

A. Refer to Specification Section 28 05 00 in addition to the following.

B. Provide dedicated raceway with applicable boxes for all fire alarm wiring in accordance with applicable sections of these specifications.

C. All initiating, indicating and auxiliary control devices shall be mounted on UL listed outlet boxes.

D. Provide supporting devices per Section 26 05 29 Hangers and Supports.

E. Identify raceways and boxes per Section 26 05 53 Identification for Electrical Systems.

3.3 WIRE/CABLE

A. Refer to Specification Section 28 05 00 in addition to the following.

B. Conductor: 98% conductivity, solid copper or stranded copper with maximum of 7 strands. If stranded conductors are used, then a compression lug shall be installed at every end. Wrapping twisted strands at terminal block screw is not acceptable. As an acceptable equivalent, stranded conductors without crimp-on lugs may be terminated into terminal strips of box-lug connectors.

C. Insulation: A type approved by NEC for the application. All cable shall be UL listed for fire-protective signaling application. Communication, Class 3 or Multi-Purpose cables shall not be substituted for FP cable types.

D. Color Coded:

1. Wiring shall be color coded as required to match existing system.
2. Permanent wire materials shall be used to identify all splices and terminations for each circuit at all junction boxes, outlet boxes, and terminations.:

E. UL:

1. General: Fire-protective signaling cable shall be UL listed as non-power limited or power limited as needed to match the output of the fire alarm equipment.
2. Non-Power Limited: Fire protective signaling circuits classified as non-power limited shall use cable listed under UL Electrical Construction Materials Directory. Category HNHT, “NON-POWER LIMITED FIRE-PROTECTIVE SIGNALING CABLE”. All such cable shall have fire resistance, listing and markings as described in NEC 760-17. Minimum cable marking shall be NPLF.
3. Power Limited: Fire protective signaling circuits classified as power limited shall use cable listed under UL Category HNIR, “POWER LIMITED FIRE-PROTECTIVE SIGNALING CABLE”. All such circuits shall be durably marked where plainly visible at terminations to indicate that it is a power-limited fire protective signaling circuit. Refer to paragraph titled “Fire Resistance of Cables” for additional requirements.
4. Fire Resistance of Cables: Power-limited fire-protective signaling circuit cables shall be UL listed as described in NEC 760-49. All such cable shall bear a cable marking that includes a Type designation as given in NEC Table 760-50. Provide Type FPL.

F. Connections of Installation Wiring:

1. Connections to Equipment: In accordance with NFPA for monitoring integrity and with the equipment manufacturer's instructions.
2. Connections of installation wiring to alarm initiating device sand alarm indicating appliances shall be monitored for integrity.
3. Interconnecting means shall be arranged so that a single break or single ground fault will not cause an alarm signal.
4. Apply a compression lug, similar to T&B Sta-Kon Terminal, to all stranded conductors at terminations or use box-lug terminal strips.
5. There shall be no wire splices. All wiring shall be continuous, uncut between devices and terminal blocks.

3.4 PULL STATION

A. Refer to Specification Section 28 05 00 in addition to the following.

B. Install at 48 inches AFF to top of device.

C. All manual stations shall be in unobstructed locations.

D. Install to comply with NFPA, ADA, and all handicap/accessibility code requirements.

E. Provide additional pull stations (from that shown on drawings) as required to comply with above requirements.

3.5 VISUAL SIGNAL DEVICES

A. Refer to Specification Section 28 05 00 in addition to the following.

B. Shall comply with the requirements of NFPA, the Americans with Disabilities Act, and other applicable handicap/accessibility codes including but not limited to:

1. The appliance shall be placed 80 in. above the highest floor level within the space or 6 in below the ceiling, whichever is lower.
2. In general, no place in any room or space required to have a visual signal appliance shall be more than 50 ft. from the signal (in the horizontal plane). In large rooms and spaces exceeding 100 ft. across, without obstructions 6 ft. above the finished floor, such as auditoriums, devices may be placed around the perimeter, spaced a maximum 100 ft. in lieu of suspending appliances from the ceiling.
3. No place in common corridors or hallways in which visual alarm signaling appliances are required shall be more than 50 ft. from the signal.

C. Provide additional visual signal devices (from that shown on drawings) as required to comply with above requirements.

3.6 END-OF-LINE DEVICE

A. Mount end-of-line device box with last device or separate box adjacent to last device in circuit. Provide and install nameplate on plate with point number and "EOL."

3.7 AUXILIARY CONTROL RELAYS

A. An auxiliary fire alarm relay used to control an emergency control device, e.g. motor controller for HVAC system fan or elevator controller shall be located within 3 ft. of the emergency control device.

B. The installation wiring between the system panel and the auxiliary fire alarm relay shall be monitored for integrity.

3.8 SPRINKLER FLOW SWITCHES

A. Coordinate the electrical and operating characteristics of the flow switches with the fire alarm panel.

B. Run conduit and wiring to the flow switches, and connect to provide an operable f supervised sprinkler alarm system per NFPA standards, state and local codes.

C. Provide all electrical including zones as required by Authority Having Jurisdiction and codes.

3.9 SPRINKLER VALVE SUPERVISORY SWITCHES

A. Coordinate the electrical and operating characteristics of the supervisory switches with the fire alarm panel.

B. Run conduit and wiring to the supervisory switches, and connect to provide an operable supervised sprinkler alarm system per NFPA standards, state and local codes.

C. Provide all electrical including zones as required by authority having jurisdiction and codes.

3.10 INSTALLATION OF AIR SAMPLING DETECTORS

A. Install per manufacture recommendations and in compliance with complete project specifications.

B. Install per all Local Codes and Standards

C. Maintain at least 500 mm (20 inches) of straight pipe before the pipe terminates at the detector.

D. Use bend or sweep elbow connectors to change the direction of the pipe. Bends maintain better airflow than elbows.

E. All sampling pipes should be fitted with an endcap.

F. System piping design shall be developed by the contractor to ensure proper system operation.

~~3.10~~3.11 INSTALLATION OF DETECTORS

A. All ceiling mounted detectors shall be installed in accordance with the requirements of NFPA 72.

B. All concealed detectors shall be provided with a remote indicating lamp installed in an occupied space (corridor, etc.) on wall or on the ceiling grid indicating the type of detector and the zone to which it is connected. Label shall be red with white lettering.

C. Label each device with point number.

~~3.11~~3.12 INSTALLATION OF DUCT DETECTORS

A. Comply with all applicable codes and standards including but not limited to:

1. NEMA Guide for Proper Use of Smoke Detectors in Duct Applications.
2. Full requirements of detector UL listing.
3. NFPA 90.
4. Refer to PART 1 - GENERAL for additional standards.

B. Location: To permit proper sampling of the air within a duct, locate supply air duct detectors downstream from fans, filters, humidifiers, and heating/cooling elements (if Codes permit). Locate supply or return air duct detectors at least six duct widths (diameters) from any opening, detector, bend, or branch connection. When physical parameters or codes make it impossible to meet the six width requirement, locate the detector as far as possible from the obstacle.

C. All brackets and hardware shall be provided as required to install detector housing in correct position. All detector housings shall be sealed as required to prevent air leakage between duct and housing.

D. All concealed detectors shall be provided with a remote indicating lamp installed in an occupied space (corridor, etc.) on wall or on the ceiling grid indicating the type of detector and the zone to which it is connected. Label shall be red with white lettering.

~~3.12~~3.13 MAIN FIRE ALARM CONTROL PANEL AND ASSOCIATED EQUIPMENT

A. Install all programming and software changes to existing fire alarm control panel to provide a complete and operational extension of the existing system as specified.

B. All functions/operations/performance specified are to match the same functions/operations/performance of the existing fire alarm system.

C. All color graphic AutoCAD bit maps shall be updated and tested.

~~3.13~~3.14 EQUIPMENT LABELING

A. Refer to Specification Section 28 05 00 in addition to the following.

B. Engraved laminate labels shall be screw installed on terminal cabinets, FACP, etc. equipment.

~~3.14~~3.15 EQUIPMENT MOUNTING

A. Refer to Specification Section 28 05 00 in addition to the following.

B. All equipment and associated wiring shall be installed in a neat manner and firmly secured with appropriate hardware in the equipment enclosure or to ceiling/wall.

~~3.15~~3.16 CABLE/DEVICE IDENTIFICATION

A. Refer to Specification Section 28 05 00 in addition to the following.

B. Provide and install permanent machine-printed cable markers/device labels on all cables/wire lines, telephone lines, modules, etc., at terminal strips, terminal cabinets and at main equipment. Numbers and markings shall also correspond to point-to-point diagrams. (See Section 26 05 53 Identification for Electrical Systems and Section 27 10 00 Premise Distribution System for additional requirements.)

~~3.16~~3.17 FIELD QUALITY CONTROL

A. Refer to Specification Section 28 05 00 in addition to the following.

B. Testing:

1. General: A final inspection of the system shall be rendered by the authorized factory representatives. Final inspection shall include a comprehensive verification audit with inspection and test of 100% of all fire alarm system equipment. Audit performers shall have license or certification acceptable to the authority with jurisdiction.
2. NFPA 72: Testing procedures shall be in accordance with NFPA 72 as stipulated for new system acceptance testing. The following paragraphs list minimum verification audit procedures that may require additional work to meet NFPA 72.
    a. Fire Alarm Control Equipment: Make a visual and functional test of all fire alarm control and auxiliary control equipment.
    b. Visual Inspection: Make a visual inspection to establish that all electrical connections and equipment are properly installed and operating.
    c. Fault Simulation: Make a functional fault simulation test on all relevant field wiring terminations to ensure that all wiring is properly supervised.
    d. Indicators: All indicators shall be tested to ensure proper function.
    e. Auxiliary Functions: All control panel auxiliary functions such as door holder release, central station connection, elevator capture, exit sign flashing and fan control shall be functionally tested to verify proper operation.
    f. Load and Stress Testing: Control panel supervisory and alarm current readings shall be taken to verify that the control panel has the appropriate power supplies and standby batteries to operate the system as required. Three minute general alarm stress tests, both under ac power and standby power, shall be conducted to further ensure complete operation of the system.

g. Annunciators: All annunciators shall be tested to ensure that each point activates properly and labeling correctly defines the area of alarm.
h. Fire Alarm Peripheral Devices: All fire alarm peripheral devices shall be functionally tested and the location and testing information recorded for each device.
i. Initiating Devices - Manual:

3. Each manual fire alarm station shall be functionally tested for alarm operation.
4. Each manual fire alarm station shall be functionally tested for proper wiring supervision.
   a. Initiating Devices - Automatic:
      1) Each automatic initiating device shall be activated in accordance with manufacturer's instructions to ensure proper operation.
      2) Each automatic initiating device shall be functionally tested for proper wiring supervision.
      3) Each automatic initiating device shall be inspected to ensure proper placement and mounting.
5. Notification Appliances:
   a. Each notification appliance shall be tested and the decibel reading taken at ten feet from the device and recorded to ensure proper operation.

      1) For speakers installed in finished spaces, audibility testing shall be done after all interior walls, partitions, furniture systems, carpet and finishes have been installed. Only the base building may be tested in "shell" condition (prior to buildout), if necessary in order to obtain occupancy certificate from local authority having jurisdiction.
      2) Each alarm signaling device shall be functionally tested for proper wiring supervision.
      3) Decibel reading shall be taken to ensure that the alarm signal level can be clearly heard in all areas of the facility and that appropriate sound-pressure level is achieved. Decibel readings shall be included on as-built documents and record documents on CD.
      4) All visual alarm indicators shall be functionally tested to ensure proper operation and that they are clearly visible.
   b. Alarm Verification: Procedures per NFPA 72.
   c. Multiplex System: Procedures per NFPA 72.
   d. Audit Reporting: Upon completion of the verification audit a report shall be sent to the Designer indicating that all fire alarm equipment has been tested and is in 100% operation. The report shall also contain the audit testing information as to the location and operational status of each peripheral device. The final report shall be generated in a format approved by the equipment manufacturer's headquarters to ensure integrity and uniformity of all audit procedure reporting.
   ~~d.~~ e. Specific testing of each elevator recall and shunt trip systems for correct operation.

C. Record of Completion:

1. A Record of Completion (certificate of compliance), as illustrated by Figure 1-7.2.1 in NFPA 72 shall be prepared for each system. Parts 1, 2, and 4 through 10 shall be completed after the system is installed and the installation wiring has been checked. Part 3 shall be completed after the operational tests have been performed. A preliminary copy of the certificate shall be given to the OAR and to any other parties requested by the OAR, after completion of the installation of the wiring tests. A final copy shall be given after completion of the operational acceptance tests.
2. Provide to the Fire Official a copy of the certification as required in Standard Fire Prevention Code article 603.7.6.
3. Provide the OAR with documentation per Florida Statues 633.701.

D. An acceptance test run shall be performed by the authorized factory representative in the presence of the Owner, OAR, Designer, and Authority Having Jurisdiction. The AHJ shall be consulted for any requirements for the condition of the system during acceptance testing. Fire alarm device testing methodology shall meet requirements of AHJ and State Fire Marshal fire safety rules and standards.

E. Coordination: Coordinate all requirements of the Work of other trades surrounding installation of the fire alarm system. Ensure installation and interface to all peripheral items required to interact with the fire alarm and communication system.

F. Posting: Provide posting of documentation required by Authority Having Jurisdiction in protective enclosure at the fire alarm control panel.

G. Fill out all programming sheets required by manufacturer. Submit sheets with O & M manuals.

~~3.17~~3.18 DEMONSTRATION

A. Refer to Specification Section 28 05 00 in addition to the following.

B. When system is complete it shall be demonstrated to OAR representative who shall be given complete instructions, parts, manuals and maintenance information.

C. Demonstrate normal and abnormal modes of operation, and required responses to each.

~~3.18~~3.19 AUTHORITY HAVING JURISDICTION

A. Refer to Specification Section 28 05 00 in addition to the following.

B. Coordinate/verify (prior to bid) the requirements of the Authority Having Jurisdiction over this project and bring any discrepancies to the Designer’s attention at least 7 days prior to bid. No changes in contract cost will be acceptable after the bid for work/equipment required to comply with the Authority Having Jurisdiction.

END OF SECTION 28 31 00

SECTION 28 43 20 - EMERGENCY FUEL SHUT OFF SYSTEM

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.

B. Related Specification Sections:

1. Refer to Specification SECTION 27 05 00 for requirements

1.2 SUMMARY

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

B. This section provides requirements for the installation and configuration of an emergency fuel shut off (EFSO) system location in the APM/ ITF South Terminal Complex (STC)

1.3 SCOPE OF WORK

A. Refer to Specification SECTION 27 05 00 and 28 05 00 in addition to the following.

B. Contractor shall provide a new EFSO system for the STC utilizing a fire alarm panel system similar to the fire alarm system used for the STC. The EFSO system shall be a standalone system and shall not be integrated with or connected to the fire alarm system in any manner.

C. Where listed on the drawing responsibility matrix, the following components shall be defined as follows.

1. Headend and Software: Contractor shall furnish, install, and program all required headend equipment and software including, but not limited to licensing, system expansion, redundancy, workstation licenses, operating software license or any other software required to support all new elements under this contract. Contractor shall be required to coordinate requirements as well as scheduling license installation. Headend and software include any panels, cabinets, management/administrative software, software licenses, programming, and components which serve the purpose of performing system-wide coordination, monitoring, data processing, control and other global functions.

2. Integration to Existing Tank Farm Monitoring System: Energizing and connecting of new components to the existing tank farm monitoring system shall be performed by the current tank farm monitoring system maintenance Contractor. The tank farm monitoring system maintenance Contractor shall perform all necessary testing to certify the system modification and perform the necessary programming changes required for a complete operating system. The work performed by the tank farm monitoring system maintenance contractor is part of the contract and shall be included in the bid price and fully coordinated by the contractor.
3. Interfaces: Contractor shall provide all system interfaces. Interfaces include 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.
4. Network Switches: Contractor shall provide a complete EFSO as described in this section. For LAN requirements, refer to specification SECTION 27 05 00. Coordinate network programming requirements with GOAA IT for EFSO operation on the GOAA network. Contractor shall coordinate patching into the network with GOAA.
5. Backbone Cable: Refer to specification SECTION 27 10 00 for requirements. Coordinate system backbone requirements with backbone cable Contractor.
6. Horizontal Cable: Contractor shall provide dedicated EFSO signal cabling as described in this section.
7. Field Devices: Contractor shall provide all field devices including, but not limited to power supplies, initiating devices, notification appliances, indicators, speakers, auxiliary devices, and similar equipment or appliances.

1.4 DESCRIPTION

A. Provide all labor, materials, equipment, and services necessary and required to provide, install and test a complete EFSO system to comply with these specifications and all regulatory requirements.

B. Provide a complete EFSO system. The system shall include but not be limited to all control panel components, power supplies, batteries, signal initiating devices, notification devices, wire, fittings, accessories, programming, software licenses, and interfaces to other systems required to provide a complete operating system.

C. The contractor shall coordinate with all other systems required to provide a complete and operational system.

1.5 SOUTH TERMINAL COMPLEX

A. All initiating devices shall be addressable. Control shall be microprocessor based and field-programmable node. All electronics shall be solid state.

B. System to be a zoned, non-coded, closed circuit supervised fire alarm system. The entire EFSO system shall be continuously electrically supervised against interruption or failure of the initiation and notification circuits including switches and electrical contacts. Detect opens, shorts, and grounds in the system.

C. Coordinate with other Work to assure completeness of system including but not limited to: conduit, raceways, outlet boxes, wire, cable, supports, surge suppression, junction boxes, pull boxes, identification, enclosures, cabinets, and grounding.

D. Provide all required control and interlock wiring between EFSO system and fuel system equipment. Controls are required to/for/from: control valve solenoids, leak detection pressure switches, water level detection switches, push buttons, alarm modules, light flashers, etc. (as applicable to Work).

E. The Contractor shall provide and install the EFSO system (including all equipment, wiring, etc.) in accordance with the manufacturer's recommendations.

1. Installation of devices shall be in accordance with the manufacturer's requirements as well as the requirements of the contract Documents. Recommendations by the manufacturer for the proper installation of the EFSO system and its equipment shall not preclude the requirements for the Contractor to comply with the requirements of the contract Documents.
2. Termination of EFSO circuits shall be in accordance with the manufacturer's recommendations, applicable requirements of the National Electric Code (NFPA 70), ADA, other applicable Codes and the Contract Documents.
3. The EFSO installer shall be responsible for ensuring that prior to bidding the project the Electrical Contractor understands the raceway requirements for the project. Claims by the Contractor after award of the project in regard to additional raceway required either by the EFSO System Manufacturer's recommendations for proper installation of the system and its associated equipment, or for compliance with the requirements of the Contract Documents, shall not be allowed.

F. The Contractor is advised that circuit routing for this system is not necessarily shown on the project drawings. The Contractor shall provide and install all raceways, wiring and cabling required for a complete and fully functional system as intended by these specifications. All wiring and/or cabling shall be in conduit. Contractor shall provide and install a properly sized, flush mounted outlet box for every device. Contractor shall size and route raceways to accommodate the proper installation of the system cabling. T-Tapped cabling shall not be acceptable. In locations where raceway and/or conduit is not accessible after completion of the project, conduit shall be routed from device to device or fire rated access panels shall be installed to provide access to junction and pull boxes. Routing of raceway from device to device shall only be acceptable where the wiring scheme of the system, as recommended by the manufacturer, requires cable to pass from device to device. Contractor shall properly terminate each device according to the manufacturer's recommendations. Provide and install firestopping where penetrations are made through rated walls and floors.

G. All EFSO cabling shall be in raceway.

H. The EFSO System shall be tested, by the Contractor, in the presence of the Fuel system operator, upon permanent installation of the equipment in the fuel tank farm control building and prior to acceptance by the Owner. This testing shall be in addition to any other testing required by these project documents. The Contractor shall be responsible for including all costs for this testing within his bid. The testing procedure shall include in-depth testing of all portions of the system that have been moved, modified or worked in as part of this project. In addition, this testing shall, as a minimum, involve random testing of devices at the discretion of the fuel system operator.

I. The EFSO system shall not share a raceway, junction box, enclosure, manhole or device with any other system.

J. Provide and install all relays as required for a complete and operational EFSO system, complying with all applicable codes and all requirements, and coordinated with all divisions of these specifications.

K. Zoning

1. Activation Zones.
    a. Activation zones are based on the pipe layout for the fuel system. Four control valves in CV-10 supply two different portions (Zones) of the hydrant piping. Any activation of a pushbutton in the zone shall cause both control valves for that zone to be closed.
        1) Zone C: Gates 236, 240, 242, 244, and 245.
        2) Zone D: Gates 245, 243, 241, 250, 251, 252, 253, 254, 255, 256, 257, and 258.
2. CV-10 Downstream Cross-Connect Valve.

a. If the CV-10 Downstream Cross-Connect Valve position indicator shows the valve in any position other than closed, Zones C and D shall be considered one zone and all four control valves in CV-10 shall be closed upon activation of any EFSO push button.

3. Gate 245 exception.
   a. Gate 245 is the physical location of CV-10 and therefore could have leak indications that could come from both zones. Therefore any activation of a pushbutton at gate 245 shall shutdown Zones C and D.

1.6 SYSTEM OPERATION

A. System operation shall meet the operation requirements of all codes and regulatory requirements.

B. Upon activation of the EFSO System by a EFSO Station push button the following shall take place:

1. Energize the blue light installed the EFSO Station and at the EFSO Panel Alarm Station.
2. Sound audible alarm installed above the push button and at the EFSO Panel Alarm Station.
3. Cause alarm to be displayed on the control panel and the graphical display at the tank farm.
4. Close all control valves in CV-10 by zone.

C. Leak Detection: Upon activation of the low pressure component of the leak detection pressure switch, the system shall provide a supervisory fault condition. Upon activation of the high pressure component of the leak detection pressure switch, the following shall take place:

1. Energize the blue light at the EFSO Panel Alarm Station.
2. Sound audible alarm at the EFSO Panel Alarm Station.
3. Cause alarm to be displayed on the control panel and the graphical display at the tank farm.

D. Liquid Level Detection: Upon activation of the low or high liquid level alarm, the system shall provide a supervisory fault condition.

E. System supervisory faults, such as shorts, opens, and grounds in conductors, operating power failure, or faults within supervised devices, shall place the system in the trouble mode, which causes the following system operations:

1. Visual and audible trouble signal indicated by zone at the EFSO control panel.
2. Visual and audible trouble signal indicated at the tank farm.

F. Manual acknowledgement function at the EFSO control panel shall silence audible signal at the control panel and the EFSO Panel Alarm Station; visual signal shall be displayed until initiating failure or circuit trouble is cleared.

G. Alarm Reset: The system shall remain in the alarm mode until manually reset with a key accessible reset function. The system shall reset only if the initiating circuits are cleared.

H. EFSO Station Reset: The system shall remain in the alarm mode until the push button is reset. The button is reset by pulling out on the button. Once the button is reset, the audible signal at the EFSO Station shall stop and the flashing blue light shall continue until the alarm reset is used at the EFSO control panel.

I. Lamp Test: manual lamp test function causes alarm indication at each lamp on the fire alarm control panel and the remote annunciator.

1.7 SUBMITTALS

A. Submit in accordance with SECTION 28 05 00 Common Work Results for ~~Electrical~~ESS.

1.8 PROJECT RECORD DOCUMENTS

A. Submit in accordance with SECTION 28 05 00 Common Work Results for ~~Electrical~~ ESS and SECTION 26 01 00 Operation and Maintenance Manuals.

1.9 O & M MANUALS

A. Submit in accordance with SECTION 28 05 00 Common Work Results for ~~Electrical~~ ESS and SECTION 26 01 00 Operation and Maintenance Manuals.

1.10 QUALITY ASSURANCE

A. Refer to Specification SECTION 28 05 00 in addition to the following.

B. Manufacturer: Company specializing in manufacturing the products specified with minimum ten (10) years experience and with service facilities within 50 miles of Project.

C. Installer:

1. Company specializing in installing the products specified with minimum ten (10) years experience and certified by the State of Florida as fire alarm installer.
2. The installing Contractor shall be a direct sales division of, or the authorized and designated distributor for, the fire alarm system manufacturer.
3. Installing Contractor shall maintain a local staff of specialists, including a Fire Alarm Planning Superintendent, for planning, installation, and service.
4. The installing Contractor shall be capable to provide emergency service 7-days-a-week, 24 hours a day. The installing Contractor shall have been actively engaged in the business of selling, installing and servicing fire alarm systems for at least five consecutive years from date of bid opening.

1.11 OWNER'S INSTRUCTION:

A. Refer to Specification SECTION 28 05 00 in addition to the following.

B. Provide instruction to the Owner's designated personnel upon completion of the system installation. Instruction shall include a functional training session on the EFSO control panel operation and on peripheral device operation, including what are normal indications and alarm indications of each type of device.

1. Videotape all training sessions and deliver (4) copies of tapes to Owner's Authorized Representative (for use in future training).

1.12 EQUIPMENT WARRANTY

A. Refer to Specification SECTION 28 05 00 in addition to the following.

B. Warrant all equipment to be new and free from defects in material and workmanship, and will, within one year from date of acceptance by GOAA, repair or replace any equipment found to be defective.

1. No charges shall be made by the installer for any labor, equipment or transportation during this period to maintain functions.
2. Respond to service call within twenty-four (24) hours after receipt of such a call.

1.13 REFERENCES AND REGULATORY REQUIREMENTS

A. Refer to Specification SECTION 28 05 00 in addition to the following.

B. The equipment and installation shall comply with, but not be limited to the current or applicable provisions of the following:

1. National Electric Code, Article 760.
2. National Fire Protection Association Standards:
   a. NFPA 70 - National Electrical Code.
   b. NFPA 72 - Application, performance, installation and maintenance of fire alarm systems and their components.
3. Underwriters Laboratories Inc. The system and all components shall be listed by Underwriters Laboratories Inc. for use in fire protective signaling system under the following standards as applicable:
   a. UL 864/UOJZ: APOU Control Units for Fire Protective Signaling Systems.
   b. UL 1481: Power Supplies for Fire Protective Signaling Systems.
4. Florida Building Code: Latest adopted edition.
5. Florida Administrative Code.
6. General: The system shall comply with all applicable Codes, Ordinances and Standards as interpreted and enforced by the local authority having jurisdiction.
7. State of Florida: Division of State Fire Marshal.

C. Each item of the EFSO system shall be listed and classified by UL and FM as suitable for purpose specified and indicated.

D. All Control Equipment shall be listed under UL category UOJZ.

E. The system controls shall be UL listed for Power Limited Applications per NEC 760. All circuits must be marked in accordance with NEC article 760-23.

F. IEEE: The EFSO system includes solid state electronic components. Therefore, the equipment manufacturer shall provide certification that all such equipment is internally protected from, or can withstand, power line surge voltages and currents as specified in Table 1, Location Category a High Exposure of ANSI/IEEE Standard C62.41-1980 (formerly IEEE Standard 587).

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide all equipment necessary for a complete EFSO system.

B. All equipment shall be new and UL listed for intended fire alarm purposes.

C. Provide all equipment to perform all functions and features even though not specifically noted or specified herein.

D. See drawings for description of devices.

E. All devices shall be addressable type.

F. Provide back box as recommended by system manufacturer for all devices.

G. System manufacturers:

1. Edwards Systems Technology
2. Siemens
3. Notifier
4. Approved equal

2.2 EFSO CONTROL PANEL (EFCP)

A. EFCP shall consist of a full height cabinet capable of supporting (3) chassis assemblies with the capability of seven local rail module spaces each. Provide with inner and outer door.

B. Shall be equipped with CPU and LCDXL display modules.

C. Provide all fiber optic communications cards as required to connect to fiber optic network connected to the tank farm.

D. POWER SUPPLY

1. The power supply for the panel and all peripheral fire alarm devices shall be integral to the control panel. The power supply shall provide all control panel and peripheral power needs as well as 3.0 amperes of unregulated 24 VDC power for external audio-visual devices. All power supplies shall be designed to meet UL and NFPA requirements for power-limited operation on all external signaling lines, including initiating circuits and indicating circuits.
2. All power supplies shall be provided by the same manufacturer as the EFSO control panel (EFCP). Power supplies provided by manufacturers other than the manufacturer of the EFCP shall not be acceptable.
3. Circuit breakers or other over-current protection on all power outputs.
4. Input power shall be 120 VAC, 60 Hz. The power supply shall provide internal batteries and charger. Internal battery capacity shall be as required.
5. The battery pack shall provide 24 hours maximum normal operating and supervisory power and, at the end of that required period of time, provide 15 minutes power to operate all alarm signals as required by NFPA 72.
6. Increase quantities/sizes of all expansion power supplies, batteries, circuits, etc., as necessary to meet NFPA 72 requirements for circuit loading, voltage drops, etc.

2.3 EFSO TERMINAL CABINET (EFTC)

A. Remote Closet Cabinets are surface mounted and come in sizes providing space three chassis, with room for standby batteries.

B. Remote Closet Cabinets have left hand hinged doors and are available with red finish only.

C. RCC cabinets can also be used as remote battery cabinets.

D. Provide all required mounting hardware and terminal strips to support all cabling and devices being installed in terminal cabinet.

E. Provide terminal strips for all field cable.

2.4 BOOSTER POWER SUPPLY (BPS)

A. Supply, where needed or as indicated on drawings, Booster Power Supplies (BPS) that are interconnected to and supervised by the main system.

B. The BPS shall function as a stand-alone auxiliary power supply with its own fully-supervised battery compliment.

C. The BPS battery compliment shall be sized to match the requirements of the main system and be capable of mounting addressable relay for control and interface.

D. The BPS shall provide a minimum of four independent, fully supervised Class B circuits that can be field configurable for notification appliance circuits or auxiliary 24 Vdc power circuits. BPS NACs shall be convertible to a minimum of two Class A NACs.

E. Each BPS output circuit shall be rated at 3 amperes at 24 Vdc. Each output circuit shall be provided with automatically restoring over current protection.

F. The BPS shall be operable from the main system NAC.

G. Fault conditions on the BPS shall not impede operation of main system NAC. The EBPS shall be provided with ground fault detection circuitry and a separate AC fail relay.

H. Provide Sync Module in BPS for all local NAC circuits.

2.5 INITIATING DEVICES

A. EFSO Station: Push button operator, Square D Class 9001, Type 4X with extended guard #SKR2RH13. Enclosure similar to #KY1. Or equal.

1. Mounting: Flush plate, stainless steel, Square D Class 9001, Type SK, similar to #K25 but shall be watertight. Or equal.

2.6 NOTIFICATION APPLIANCES

A. General:

1. All notification devices shall be white in color
2. All notification devices shall be rated for exterior use.

B. Visual Alarm Devices:

1. EFSO Station Light: Incandescent lighting fixture with 100 watt incandescent equivalent LED bulb and guard. Crouse Hinds #VGR116 and blue globe #VN73 gasket. Or equal.
2. EFSO Panel Alarm Station: Strobe warning light, 120V, with blue color dome. Unit shall be weatherproof. Federal Signal Corp. Model #LP3P or equal.

C. Horns: Vibrating horn, 120v, with 4” square outlet box and grill for flush mounting. Federal Signal Corp. Model #350 +FG+FB or equal.

2.7 AUXILIARY DEVICES

A. Power supplies, controllers, modules, relays, housings, etc. as required by system manufacturer to support all devices required for a complete and operational system.

B. Isolation Modules:

1. The Isolator Module (IM) is an addressable device that protects a signaling line circuit (SLC) from a wire-to-wire short.

2. The module monitors line voltages and opens the data line when a short is detected, isolating the short between the two modules located electrically closest to the short.
3. The loop controller assigns an address to the module.
4. The module uses one detector address on the SLC.

C. Addressable control Modules:

1. Provide Input / Output / relays as required and as shown on details
2. Where installed in motherboards provide appropriate version.

D. Addressable Circuit Interface Modules:

1. Addressable Circuit Interface Modules: Arrange to monitor one or more system components that cannot otherwise be equipped for multiplexing communication. Modules transmit identification and status to the EFCP using a communication transmitter and receiver with unique identification and capability for status reporting to the EFCP. Modules shall be used for monitoring of non-addressable devices such as valve position.
2. Addressable Circuit Interface Modules shall be capable of mounting in a standard electric outlet box.

E. Control Relays: UL listed SPDT or DPDT 10 amp rated contacts, status LED. Provide metal enclosure w/LED Viewing Port

1. A single relay may be energized from a voltage source of 24 Vdc, 24 Vac, 115 Vac or 230 Vac by wiring to appropriate input terminals.
2. Each relay position contains a red light emitting diode (LED) which indicates the relay coil is energized.
3. Provide dust proof metal enclosure with LED viewing hole for all modules.

PART 3 - EXECUTION

3.1 GENERAL

A. Refer to Specification SECTION 28 05 00 in addition to the following.

B. All of the work specified in this section shall be included within the scope of the contract. The contractor shall retain the current tank farm monitoring system maintenance Contractor to perform, at a minimum, the following tasks:

1. Provide any programming required for the tank farm monitoring system.
2. Update the system as-built drawings, CAD files and bitmaps.

C. Locate, install, and EFSO system in accordance with the equipment manufacturer’s written instructions, and the latest editions of the NFPA, the National Electrical Contractor’s Association publication “Standard of Installation” and all applicable codes referenced in this specification.

D. Provide all work required for a complete system including complete system testing and checkout. All components shall be properly mounted and wired. The installation of this system shall comply with the directions and recommendations of authorized factory representatives.

E. Provide wiring, cabling, raceways, and electrical boxes in accordance with manufacturer's written instructions.

F. Components shall be electrically "burned-in" by operating the component at full power for a period as recommended by the manufacturer.

G. Installation shall be done in a neat workmanlike fashion by a firm regularly engaged in Fire Alarm Installation and Service.

H. The installation and inspection of all EFSO devices and systems shall be performed by, or under the direct on-site supervision of, a licensed fire alarm technician or a fire alarm planning superintendent who shall certify the work upon completion of the activity. The certifying licensee shall be present for the final test prior to certification.

I. Installation plans and wiring diagrams shall bear the signature and license number of the licensed Fire Alarm Planning Superintendent, the date of installation and the name, address, and certificate-of-registration number of the registered firm.

J. All components shall be completely wired. System shall be fully operable when main power service has failed and the Emergency Standby Generator has assumed emergency system loads. This shall require that any devices which required 120 volt power shall receive supply from an emergency 120 volt source.

K. Power supplies are to be loaded to a maximum of 75% of their capacity. Provide additional power supplies where required to comply with this maximum loading requirement.

3.2 RACEWAYS AND BOXES

A. Refer to Specification SECTION 28 05 00 in addition to the following.

B. Provide dedicated raceway with applicable boxes for all EFSO wiring in accordance with applicable sections of these specifications.

C. All initiating, indicating and auxiliary control devices shall be mounted on UL listed outlet boxes.

D. Provide supporting devices per SECTION 26 05 29 Hangers and Supports.

E. Identify raceways and boxes per SECTION 26 05 53 Identification for Electrical Systems.

3.3 WIRE/CABLE

A. Refer to Specification SECTION 28 05 00 in addition to the following.

B. Conductor: 98% conductivity, solid copper or stranded copper with maximum of 7 strands. If stranded conductors are used, then a compression lug shall be installed at every end. Wrapping twisted strands at terminal block screw is not acceptable. As an acceptable equivalent, stranded conductors without crimp-on lugs may be terminated into terminal strips of box-lug connectors.

C. Insulation: A type approved by NEC for the application. All cable shall be UL listed for fire-protective signaling application. Communication, Class 3 or Multi-Purpose cables shall not be substituted for FP cable types.

D. Color Coded:

1. Wiring shall be color coded as required to match existing fire alarm system.
2. Permanent wire materials shall be used to identify all splices and terminations for each circuit at all junction boxes, outlet boxes, and terminations.:

E. UL:

1. General: Fire-protective signaling cable shall be UL listed as non-power limited or power limited as needed to match the output of the fire alarm equipment.
2. Non-Power Limited: Fire protective signaling circuits classified as non-power limited shall use cable listed under UL Electrical Construction Materials Directory. Category HNHT, “NON-POWER LIMITED FIRE-PROTECTIVE SIGNALING CABLE”. All such cable shall have fire resistance, listing and markings as described in NEC 760-17. Minimum cable marking shall be NPLF.
3. Power Limited: Fire protective signaling circuits classified as power limited shall use cable listed under UL Category HNIR, “POWER LIMITED FIRE-PROTECTIVE SIGNALING CABLE”. All such circuits shall be durably marked where plainly visible at terminations to indicate that it is a power-limited fire protective signaling circuit. Refer to paragraph titled “Fire Resistance of Cables” for additional requirements.
4. Fire Resistance of Cables: Power-limited fire-protective signaling circuit cables shall be UL listed as described in NEC 760-49. All such cable shall bear a cable marking that includes a Type designation as given in NEC Table 760-50. Provide Type FPL.

F. Connections of Installation Wiring:

1. Connections to Equipment: In accordance with NFPA for monitoring integrity and with the equipment manufacturer’s instructions.
2. Connections of installation wiring to alarm initiating device sand alarm indicating appliances shall be monitored for integrity.
3. Interconnecting means shall be arranged so that a single break or single ground fault will not cause an alarm signal.
4. Apply a compression lug, similar to T&B Sta-Kon Terminal, to all stranded conductors at terminations or use box-lug terminal strips.

5. There shall be no wire splices. All wiring shall be continuous, uncut between devices and terminal blocks.

3.4 EFSO STATION

A. Refer to Specification SECTION 28 05 00 in addition to the following.

B. Install push button at 54 inches AFF to top of device.

C. Install horn at 66 inches AFF to top of device.

D. Install blue light at 78 inches AFF to top of device.

E. Install sign at 84 inches AFF to bottom of sign.

F. All stations shall be in unobstructed locations.

3.5 EFSO PANEL ALARM STATION

A. Refer to Specification SECTION 28 05 00 in addition to the following.

B. Install horn at 72 inches AFF to top of device.

C. Install blue light at 80 inches AFF to bottom of device.

D. Install sign at 108 inches AFF to bottom of sign.

E. Station shall be in unobstructed location.

3.6 END-OF-LINE DEVICE

A. Mount end-of-line device box with last device or separate box adjacent to last device in circuit. Provide and install nameplate on plate with point number and “EOL.”

3.7 AUXILIARY CONTROL RELAYS

A. The installation wiring between the system panel and the auxiliary relay shall be monitored for integrity.

3.8 EQUIPMENT LABELING

A. Refer to Specification SECTION 28 05 00 in addition to the following.

B. Engraved laminate labels shall be screw installed on terminal cabinets, EFCP, etc. equipment.

3.9 EQUIPMENT MOUNTING

A. Refer to Specification SECTION 28 05 00 in addition to the following.

B. All equipment and associated wiring shall be installed in a neat manner and firmly secured with appropriate hardware in the equipment enclosure or to ceiling/wall.

3.10 CABLE/DEVICE IDENTIFICATION

A. Refer to Specification SECTION 28 05 00 in addition to the following.

B. Provide and install permanent machine-printed cable markers/device labels on all cables/wire lines, telephone lines, modules, etc., at terminal strips, terminal cabinets and at main equipment. Numbers and markings shall also correspond to point-to-point diagrams. (See SECTION 26 05 53 Identification for Electrical Systems and SECTION 27 10 00 Premise Distribution System for additional requirements.)

3.11 FIELD QUALITY CONTROL

A. Refer to Specification SECTION 28 05 00 in addition to the following.

B. Testing:

1. General: A final inspection of the system shall be rendered by the authorized factory representatives. Final inspection shall include a comprehensive verification audit with inspection and test of 100% of all EFSO system equipment. Audit performers shall have license or certification acceptable to the authority with jurisdiction.
2. Each EFSO station shall be functionally tested for alarm operation.
3. Each EFSO station shall be functionally tested for proper wiring supervision.
    a. Initiating Devices - Automatic:
        1) Each automatic initiating device shall be activated in accordance with manufacturer's instructions to ensure proper operation.
        2) Each automatic initiating device shall be functionally tested for proper wiring supervision.
        3) Each automatic initiating device shall be inspected to ensure proper placement and mounting.

C. An acceptance test run shall be performed by the authorized factory representative in the presence of the Owner, OAR, Designer, and Authority Having Jurisdiction. The AHJ shall be consulted for any requirements for the condition of the system during acceptance testing.

D. Coordination: Coordinate all requirements of the Work of other trades surrounding installation of the EFSO system. Ensure installation and interface to all peripheral items required to interact with the EFSO system.

E. Fill out all programming sheets required by manufacturer. Submit sheets with O & M manuals.

3.12 DEMONSTRATION

A. Refer to Specification SECTION 28 05 00 in addition to the following.

B. When system is complete it shall be demonstrated to OAR representative who shall be given complete instructions, parts, manuals and maintenance information.

C. Demonstrate normal and abnormal modes of operation, and required responses to each.

3.13 AUTHORITY HAVING JURISDICTION

A. Refer to Specification SECTION 28 05 00 in addition to the following.

END OF SECTION 28 43 20

SECTION 31 20 00 – EARTH MOVING FOR BUILDING SLABS

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. Section Includes:

1. Preparing subgrades for slabs-on-grade.
2. Excavating and backfilling for buildings and structures.

B. This section applies to earth moving for the building slabs only. All other earth moving shall follow FDOT standard specifications as noted in Section 347000.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and up to 12 inches above pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

C. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by OAR. Authorized additional excavation and replacement material will be paid for according to Contract.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

D. Fill: Soil materials used to raise existing grades.

E. Structures: Buildings, footings foundations, retaining walls, slabs, tanks, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

F. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below slab-on-grade.

G. Utilities: Underground services within buildings.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

1. Warning tapes.

B. Samples for Verification: For the following products, in sizes indicated below:

1. Warning Tape: 12 inches (300 mm) long; of each color.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each on-site soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D 2487.
2. Laboratory compaction curve according to ASTM D 1557.

C. Blasting is not permitted.

D. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth-moving operations. Submit before earth moving begins.

1.6 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

1.7 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Utility Locator Service: Notify all utility agencies for area where Project is located before beginning earth-moving operations, including FAA.

C. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified in plans and FDOT specifications are in place.

D. Do not commence earth-moving operations until plant-protection measures specified in plans are in place.

E. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

F. Do not direct vehicle or equipment exhaust towards protection zones.

G. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Unified Soil Classification Groups SP, SP-SM and SM (up to 18% passing the #200 sieve), or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Unified Soil Classification Groups SM (with greater than 18% passing the #200 sieve), SM-SC, SC, CL, CH, ML, MH, OL, OH and PT, or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

2.2 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.

B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
2. Maintain the groundwater table a minimum of two feet below all compaction surfaces. Temporary dewatering may be required to maintain this two-foot vertical separation.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

B. Muck Excavation: Muck excavation shall consist of the removal and disposal of deposits or mixtures of soils and organic matter not suitable for foundation material. Muck shall include materials that will decay or produce subsidence in the embankment. It may consist of decaying stumps, roots, logs, humus or other material not satisfactory in the embankment.

~~C. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Architect. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents.~~

3.5 SUBGRADE INSPECTION

A. Notify OAR when excavations have reached required subgrade.

B. If Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below the building slabs with a large vibratory roller (Dynapac CA-25 or equivalent) to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade with a minimum of 5 passes in each of two perpendicular directions. Limit vehicle speed to 3 mph (5 km/h).
2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

3. Exercise extreme caution when operating vibratory equipment near existing structures. Operate roller in the static mode or use non-vibratory compaction equipment if excessive vibrations are experienced by any nearby structures.
4. Continue proof-rolling until the subgrade at a depth of 12 inches below the compaction surface has attained a minimum of 95% of the soil's modified Proctor maximum dry density as determined by ASTM Standard D-1557.

D. Authorized additional excavation and replacement material will be paid for according to Contract.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by OAR, without additional compensation.

3.6 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi (17.2 MPa), may be used when approved by Engineer.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Engineer.

3.7 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.8 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring, bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

C. Backfill voids with satisfactory soil while removing shoring and bracing.

D. Revise tape depths in "Warning Tape" Paragraph below to suit office practice if applicable.

E. Warning Tape: Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs, or 12 inches above utility as deemed appropriate to suit office practice per 3.8.D.

3.9 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations. All fill shall be satisfactory soil material.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.10 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.11 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 12 inches in loose depth for material compacted by heavy compaction equipment and not more than 6 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.

3.12 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1 inch.
3. Pavements: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.13 FIELD QUALITY CONTROL

A. Special Inspections: The OAR will engage a qualified special inspector to perform the following special inspections:

1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
2. Determine that fill material classification and maximum lift thickness comply with requirements.
3. Determine, during placement and compaction, that in-place density of compacted fill complies with requirements.

B. Testing Agency: The Contractor will engage a qualified geotechnical engineering testing agency to perform quality control tests and inspections.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by OAR.

E. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2937, and ASTM D 6938, as applicable. Tests will be performed at the following locations and frequencies:

1. Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2,500 sq. ft. or less of building slab area but in no case fewer than three tests.

F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.14 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by OAR; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.15 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by OAR.

1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 31 20 00

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SECTION 31 31 16 - TERMITE CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Soil treatment.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction material descriptions for termite control products.
2. Include the EPA-Registered Label for termiticide products.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Certificates: For each type of termite control product.

C. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's records and include the following:

1. Date and time of application.
2. Moisture content of soil before application.
3. Termiticide brand name and manufacturer.
4. Quantity of undiluted termiticide used.
5. Dilutions, methods, volumes used, and rates of application.
6. Areas of application.
7. Water source for application.

D. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located and who employs workers trained and approved by manufacturer to install manufacturer's products and who is accredited by manufacturer.

1.7 FIELD CONDITIONS

A. Soil Treatment:

1. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.
2. Related Work: Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

1.8 WARRANTY

A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work consisting of applied soil termiticide treatment will prevent infestation of subterranean termites, including Formosan termites (Coptotermes formosanus). If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain termite control products from single source from single manufacturer.

2.2 SOIL TREATMENT

A. Termiticide: EPA-Registered termiticide acceptable to authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. BASF Corp. - Construction Chemicals.
   b. Bayer Environmental Science.
   c. Ensystex, Inc.
   d. Syngenta.
2. Service Life of Treatment: Soil treatment termiticide that is effective for not less than five years against infestation of subterranean termites.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.

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

3.2 PREPARATION

A. General: Prepare work areas according to the requirements of authorities having jurisdiction and according to manufacturer's written instructions before beginning application and installation of termite control treatment(s). Remove extraneous sources of wood cellulose and other edible materials, such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.

B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated, except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.

1. Fit filling hose connected to water source at the site with a backflow preventer, according to requirements of authorities having jurisdiction.

3.3 APPLYING SOIL TREATMENT

A. Application: Mix soil treatment termiticide solution to a uniform consistency. Distribute treatment uniformly. Apply treatment at the product's EPA-Registered Label volume and rate for maximum specified concentration of termiticide to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction.

1. Slabs-on-Grade and Basement Slabs: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
2. Foundations: Soil adjacent to and along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing.
3. Crawlspaces: Soil under and adjacent to foundations. Treat adjacent areas, including around entrance platform, porches, and equipment bases. Apply overall treatment only where attached concrete platform and porches are on fill or ground.
4. Masonry: Treat voids.
5. Penetrations: At expansion joints, control joints, and areas where slabs and below-grade walls will be penetrated.

B. Post warning signs in areas of application.

C. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

3.4 PROTECTION

A. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.

B. Protect termiticide solution dispersed in treated soils and fills from being diluted by exposure to water spillage or weather until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

END OF SECTION 31 31 16

SECTION 31 35 23.23 – FABRIC FORMED CONCRETE RIPRAP

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

Furnish all materials, equipment, labor and perform all operations for placing fabric formed concrete riprap as shown on the plans and specified herein.

Prepare and grade the slopes or surfaces to be protected to such an extent that they are normally stable in the absence of erosive forces. Obtain the Engineer's approval of fill material required to restore the slopes to original condition. Position a fabric envelope in a mat configuration over the surface and fill with a pumpable sand/cement grout in a way that forms a stable mat of suitable weight and configuration.

PART 2 - MATERIALS

The structural grout shall consist of a mixture of portland cement, fine aggregate, and water so proportioned and mixed as to provide a pumpable slurry. Pozzolan and grout fluidifier conforming to these specifications may be used. Submit the proposed mix design for approval with substantiating tests as follows:

1. Portland cement conforms to FDOT Section 921, Type I and Type II.

2. Fine aggregate conforms to FDOT Section 902 for concrete aggregate, except as to grading. Aggregate grading shall be reasonably consistent and well graded from a maximum size which can be conveniently handled with available pumping equipment.

3. Water conforms to FDOT Section 923.

4. Pozzolan conforms to FDOT Section 929 and if used, is in amounts of 10 to 30% by weight of the cement content.

5. Grout fluidifier conforms to FDOT Section 924 for Water Reducing and Retarding Admixtures. The admixtures may be used to reduce segregation, increase workability and pumpability, improve strength and water-tightness.

6. Air-Entraining Admixtures conform to FDOT Section 924. The air content shall not exceed 7% of the volume of the grout.

7. Demonstrate the suitability of fabric and grout design by injecting the proposed grout into three 6 inch [150 mm] diameter sleeves under a pressure of 10 to 15 psi [70 to 100 Kpa] maintained by means of air pressure or a stand pipe for 10 minutes. Construct the sleeves of the same fabric used in the individual layers of fabric. A 6 inch by 12 inch [150mm by 300mm] cylindrical test sample shall be cut from each sleeve and tested in accordance with

ASTM C 39.

Ensure that the average compressive strength of the cylindrical test sleeve is at least 20% higher at 7 days than that of three companion 6 inch by 12 inch [150mm by 300mm] test cylinders made in accordance with ASTM C 31, and not less than 2500 psi [17 MPa] at 28 days.

Use fabric forming material consisting of specifically woven, double layer, open selvage fabric jointed in mat configuration. The fabric shall consist of uncoated synthetic yarns with sufficient tensile strength and porosity to withstand the pressure of the grout injection pump without breaking the layers of fabric.
The two fabric layers shall each be no lighter than 18 by 18 count/ inch [/25 mm], 0.111 g/m (formerly 1000 denier) nylon or polyester tire cord, of which at least 50% by weight shall be producer-bulked continuous multifilament tire cord nylon. Fabric of equal or greater strength and porosity may be used with the approval of the Engineer. Fabric containing film type polypropylene fiber will not be considered as an acceptable alternate.
Cut individual mill width panels to suitable length and separately join the two layers of fabric edge to edge using nylon thread. The tensile strength of stitched joints shall be not less than 100 lbs/inch [18 N/mm].

Provide hydrostatic uplift relief by installing filter points woven in a way that permits passage of water through the filter points spaced at approximately 8 inch [200 mm] centers as indicated on the plans.

PART 3 - EQUIPMENT

Mixing and pumping equipment used in preparation and handling of the grout shall be approved in accordance with Section 100-2. Remove all oil or other rust inhibitors from the mixing drums, stirring mechanisms, and other portions of the equipment in contact with the grout before the mixers are used. The pumping equipment shall have a variable flow rate to provide enough pressure for pumping without breaking the fabric.

Accurately measure all materials by volume or weight as they are fed into the mixer. The quantity of water shall be such as to produce a grout having a pumpable consistency. Mix for no less than one minute. If agitated continuously, the grout may be held in the mixer or agitator for a period not exceeding 2.5 hours in temperatures below 70° F [21 C], and for a period not exceeding 2 hours at higher temperatures. If there is a lapse in a pumping operation, recirculate the grout through the pump or through the mixer drum (or agitator) and pump.

PART 4 – CONSTRUCTION METHODS

Before injecting grout, position the fabric at its design location. Each panel shall be a continuous or monolithic unit for its full width, including the trench portion.

Each panel shall consists of two or more mill widths of open selvage construction; join the two upper layers together by sewing, and the two bottom layers together at the edges. Where adjacent panels cannot be joined in this manner, lap them a minimum of 24 inch [600 mm]. Simple butt joint, either sewn or unsewn, will not be allowed. Place the ends and upper limits of the fabric mat in a trench of suitable width as shown on the plans.

Make small cuts in the fabric to allow for the insertion of the grout hose or grout nozzle. Introduce grout into the space between the layers of fabric and inject in a way that excessive pressure on the fabric envelope is avoided. Starting at the lowest elevation and working up the slope, inject the grout

in a way that the distance from the point of injection to the end of the panel is not greater than 30 feet [9 m]. After grouting has been completed, backfill the void between trench wall and filled fabric.

Holes in the fabric left by the removal of the grout hose or inserts shall be temporarily closed by inserting a piece of burlap or similar material. Remove the burlap when the mortar is no longer fluid and the surface is firm to hand pressure. Limit foot traffic on the filled fabric formed concrete riprap to an absolute minimum for one hour after pumping in order to reduce indentation.

PART 5 – ACCEPTANCE SAMPLING AND TESTING

Acceptance is based on achieving a 28 day compressive strength of 2500 psi [17 MPa]. For each 500 yd^2 [400 m^2] or less of placement, The Engineer will make two 6 inch by 12 inch [150mm by 300mm] cylinders and test at 28 days according to ASTM C-39.

PART 6 – METHOD OF MEASUREMENT

The quantity to be paid for under this Section will be paid for at the Contract unit price per square yard [per square meter]. Measurements will include portion of the riprap in trenches and no allowance will be made for overlaps.

PART 7 – BASIS OF PAYMENT

The quantity to be paid for as provided above will be at the Contract unit price per square yard [square meter] for Fabric Formed Concrete Riprap measured as specified above and adjusted as specified herein.

The unit price will be reduced when the average strength of the acceptance LOT of grout is less than the specified minimum compressive strength. The unit price reduction will be in accordance with the following schedule:

Average strength less than that specified in Part 5 by:	**Percentage reduction in base unit price**
100 to 199 psi [0.7 to 1.37 MPa]	1
200 to 299 psi [1.38 to 2.06 MPa]	3
300 to 399 psi [2.07 to 2.75 MPa]	5
400 to 499 psi [2.76 to 3.44 MPa]	10
over 500 psi [3.45 MPa]	25

Price and payment will be full compensation for all work, labor, equipment and materials required.

END OF SECTION 31 35 23.23

SECTION 31 6316 - AUGER CAST PRESSURE-GROUTED DISPLACEMENT PILES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Information concerning a sub-surface soil investigation by an independent testing laboratory is available and will be furnished by the owner upon request. The data included therein may be used by the Contractor for his general information only. The Architect/Engineer will not be responsible for the accuracy or applicability of the data therein.

1.2 SCOPE OF WORK

A. The Pile Contractor shall furnish all materials, labor, services, equipment and shall install and cut off all piles at the locations and depths shown on the drawings. The Auger cast pressure grouted displacement (APGD) piles shall be installed to have minimum working capacity as indicated in the General Notes on the drawings. The piles shall be free of defects, mud inclusions, voids, or other anomalies which can adversely influence pile performance.

B. The Pile Contractor shall furnish and place all reinforcing steel and dowels as shown on the drawings.

C. The Pile Contractor shall furnish all materials and labor as required to perform the pile load tests, monitoring and reporting as specified herein and on the drawings.

D. The Contractor shall provide all necessary excavation, sheeting and bracing or other adequate maintenance of excavation banks, suitable runways and ramps as necessary for pile driving, control of ground and surface water as necessary to keep the work area sufficiently dry without causing damage to the adjacent structures, suitable access roads for movement of equipment and materials to and from pile locations, site survey - field layout required for pile work including setting and maintaining a location stake for each pile and giving cut-off grades on all piles, and removal of all overhead and underground obstructions as required.

E. The Owner’s Authorized Representative (OAR’s) Geotechnical Engineering Firm shall observe the installation of all test piles and production piles and shall observe the load tests. Sample of the grout mix and tests should be performed for all piles. Owner’s Authorized Representative shall observe fabrication and installation of the pile reinforcing steel.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
1. Before start of work the require representatives of each entity directly concerned with APGD to attend, including the following:
a. Contractor's superintendent.
b. Independent testing agency responsible for grout design mixtures.
c. Ready-mix grout manufacturer.
a. Specialty Subcontractor.
2. Review the installation plan along with the testing requirements.

~~1.3~~1.4 QUALIFICATIONS

A. Piles shall be installed only by a specialty Pile Contractor with suitable equipment, competent personnel, and a reputation of satisfactorily performing the work. The Pile Contractor and his onsite Supervisor shall have a minimum of 5 years' auger cast pile experience and a minimum of 5 successful APGD pile installations on projects comparable in scope and subsurface conditions to this project. Evidence of compliance with this section shall be submitted to the Architect/Engineer prior to entering into a contract for the work.
1. Comparable Project is defined as a project with 14" to 18" diameter piles within similar soil conditions and a minimum of 100 piles per project.

B. The Pile Contractor's On Site Supervisor Shall have a minimum of 5 years' experience supervising comparable APGD projects.

~~1.4~~1.5 QUALITY ASSURANCE

A. The Contractor is responsible for quality control, including workmanship and materials furnished by his subcontractors and suppliers.

B. The Pile Contractor shall comply with all provisions of the local building code and all other codes and standards specified on the drawings.

C. The Contractor shall preserve all work in good condition until final measurement and until the records have been examined and approved.

~~1.5~~1.6 JOB CONDITIONS

A. Site Information:
1. Data on indicated subsurface conditions are not intended as representations or warranties of continuity of such conditions. The data is indicative of the conditions at the boring and sounding locations at the time the borings and soundings were performed. It is expressly understood that Owner will not be responsible for interpretations or conclusions drawn therefrom by the Contractor. The data are made available for convenience of the Contractor.

2. Additional test borings and other exploratory operations may be made by the Contractor at no additional cost to the Owner. Notify and obtain approval from Owner prior to drilling borings.

B. Protection of Existing Structures: Protect structures, underground utilities and other construction from damage caused by pile augering operations.

~~1.6~~1.7 ACTION SUBMITTALS:

A. Sustainable Design Documentation Submittals: Refer to section 01 8113.14 "Sustainable Design Requirements – LEED V4 BD+C".

1. Product Data: Documentation for Leadership Extraction Practices in the following:
   a. Regional/Local Multiplier Compliance
   b. Leadership Extraction Practices for Recycled Content
2. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD's)
   b. Corporate Sustainability Reporting (CSR's)

B. The Contractor shall submit a detailed written installation plan including pile numbering plan, site preparation, methods, procedures, and equipment.

C. Grout Mix Design: Contractor shall submit grout mix design for review and approval by the Engineer of Record at least 15 days prior to commencement of pile installation.

D. Drilling Records: The Pile Contractor and the OAR's Geotechnical Engineer shall each submit copies of the drilling record of each pile to the Architect/Engineer not later than 48 hours after drilling. The reports shall indicate the name of job, name of pile contractor, and drilling superintendent. For each pile installed, the report shall include the following information:
1. Pile designation/number
2. Post-construction survey information
3. Pile diameter and length
4. Actual tip elevation
5. Actual surface elevation (top of grout)
6. Grout compressive test results (when available),
7. Theoretical volume of grout and actual volume of grout placed
8. Reinforcing steel size and depth actually placed
9. Drilling start and finish time
10. Grouting start and finish time
11. Amount of drop in grout level in 24 hours
12. Pile condition and soundness with respect to pile cut-off operations
13. photographic log of exposed pile group

E. Reports prepared by the OAR's Geotechnical Engineer shall be compiled and signed by a registered professional engineer in the State of Florida.

F. Reports prepared by the Pile Contractor shall be compiled and signed by the drilling superintendent. The Contractor shall submit a comprehensive submittal for each pile cap, including information outlined in this section and GC acceptance (signed shop drawing stamp), for review by the Engineer of Record. Only those pile caps which have been returned to the Contractor by the Engineer of Record with no exception taken or supplemental marked-up information shall pile cap construction commence.

G. Load Test: The Contractor shall submit for review 14 days prior to installation of the test piles or reaction piles a plan detailing the load test set-up and increments of loading for each axial compressive load test. In addition, jack and load cell calibration data and vibrating wire rebar strain meter calibration data shall be submitted for review 14 days prior to the installation of the load test piles.

H. Load Test Reports: The Pile Contractor shall submit copies of test reports for each load test within 48 hours after completion of tests. The report shall include pile load test capacity, compressive test reports of the pile grout, tabular and graphical presentation of gross and net settlement of the pile top, and pile data as prescribed in the previous section.

I. The OAR's Geotechnical Engineer shall review the load test reports and provide recommendations for production pile installation.

J. Alternates: The Pile Contractor shall submit their bid based on the specifications as written without exceptions. He may submit bids for alternates to the specifications or modifications to the design, load test program, or installation specifications for consideration by the Architect/Engineer and the Owner.

K. Shop Drawings: Submit shop drawings for review prior to construction. Shop drawings shall include, for each pile, pile number, location, top of pile elevation, grout design strength, sizes and lengths of piles, type and arrangement of reinforcing steel and dowels.

L. Calculations: Calculations sealed by a registered professional engineer in the State of Florida shall be submitted to verify any pile design and reinforcing steel different from that shown on the drawings. Installation shall not commence until such calculations have been reviewed and approved.

M. Load Test Frame: Submit shop drawings of the load test frame sealed by a registered professional engineer in the State of Florida.

N. Post-Construction Survey: After completion of pile installation, the Contractor shall provide the Architect/Engineer of Record/OAR's Geotechnical Engineering Firm with an as-built survey showing the actual locations of the piles at cut-off elevations to within 3/16-inch accuracy. This survey shall show the plumbness of vertical piles, the slope of batter piles, and all abandoned piles and their replacements. The pile location data shall be presented in a graphical and tabulated format depicting the

distance from the theoretical pile location. In order to facilitate the progress of the Work, the Contractor shall submit partial pile surveys for approval as the Work proceeds.

O. The Contractor shall not remove pile installation rigs from the site until as-built pile surveys have been reviewed and approved by the Architect/Engineer and the OAR's Geotechnical Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Regional Materials: Concrete and grout shall be manufactured within 100 miles of Project site from aggregates that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

B. Grout: The cement-base non-shrink grout used to fill the augered hole shall consist of a mixture of Portland Cement, fine aggregate (sand), mineral filler (where used), fluidifier, and water. The grout shall be proportioned and mixed so as to be capable of maintaining solids in suspension without appreciable water gain and will penetrate and fill any voids in the foundation soils. The 28-day compressive strength, as determined by grout cube tests, shall be 5500 psi minimum unless shown otherwise on the drawings. The maximum water-cement ratio at the point of placement shall be 0.45. The flow cone rate shall be 10 sec to 25 sec measured from a cone with ¾" diameter orifice and sampled in accordance with ASTM C172 following addition of the fluidifier and proper mixing.

C. Cementitious Materials:
   1. Portland Cement: Portland cement shall conform to ASTM C150, Type I or II.
      a. Manufacturers:
         1) Cemex
         2) Argos
         3) Or approved substitution
   2. Fly Ash: ASTM C 618, Class F, 20% maximum by weight.
      a. The contractor shall provide a minimum of 10% fly ash by weight.

D. Fine Aggregate: Fine aggregate (sand) shall consist of hard, dense, durable, uncoated rock particles free from injurious amounts of silt, loam, lumps, soft or flaky particles, shale, alkali, organic matter, mica, and other deleterious substances and shall meet the requirements of ASTM C33. The sand shall be well graded from fine to coarse, with a fineness modulus between 1.4 and 3.4.

E. Mineral Filler: Mineral filler, when used, shall conform to ASTM C618 and shall be finely powdered silicous material which possesses the property of combining with the lime liberated during the process of hydration of Portland cement.

F. Fluidifier: Fluidifier shall be a compound possessing characteristics which will increase the fluidity of the grout, reduce bleeding, assist in the dispersal of cement grains, and neutralize the setting shrinkage of the grout. Admixtures should be certified by the manufacturer to be compatible with other admixtures and to not contain more than 0.1 percent chloride ions by mass of Portland cement, or cementitious material.

G. Water: Shall be obtained from a c~~C~~lean, fresh, and potable source.

H. Reinforcing Steel: ASTM A615, Grade 60.

I. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **60** percent.

2.2 AUGERING EQUIPMENT

A. The injection port through which the grout is discharged during the pile pumping procedures shall be located at the bottom of the auger below the cutting steel.

B. The pile installation equipment shall include a displacing element to either horizontally displace the in-situ soils during drilling and to prevent soil cuttings and/or grout from climbing up the auger flighting during drilling and grouting. The Pile Contractor shall submit plans of the auger flighting and equipment to the OAR's Geotechnical Engineer for his review.

C. The pile installation equipment shall be of adequate size, power, torque and down thrust to achieve the required tip elevation and maintain specified grout pressure and delivery volume. Equipment shall include systems to monitor and correct plumbness of the mast prior to and during pile installation. Pumps, gauges, and stroke counters shall be calibrated to accurately measure pump strokes.

2.3 GROUT MIXING AND PUMPING EQUIPMENT

A. Only approved mixing and pumping equipment, free of oil or rust inhibitors, shall be used in the preparation and handling of the grout. All materials shall be such as to produce a homogeneous grout of the desired consistency.

B. Only ready-mix grout shall be used with an agitator of sufficient size between the ready-mix truck and the grout pump to insure a homogeneous mix and continuity in the pumping operations.

C. The grout pump shall be a positive displacement piston type pump with the capability of developing displacing pressures not less than 400 psi at the pump. The pump shall have a pressure gauge in good working condition which indicates grout pumping pressure. The pump shall be equipped with a device to determine the volume of grout pumped into each pile.

D. The grout pump shall be calibrated at the beginning of each work day to determine the volume of grout delivered per stroke, and recalibrated after repairs and/or maintenance which could affect the pump performance. The Pile Contractor shall provide a positive method of counting pump strokes. Such methods may include digital or mechanical counters, or other methods acceptable to the OAR's Geotechnical Engineer. A screen to remove over-size particles shall be placed at the pump outlet.

E. Real-time measurement of grout pressure and depth shall be displayed in the operator's compartment and on a remote display that can be easily viewed by the inspector. The Pile Contractor shall provide electronics and hardware capable of producing a permanent record of each installation. The record shall include, as a minimum, a graphical record of torque (as indicated by the fluid pressure of the

motors driving the turntable), grout pressure (measured at the top of the tooling), depth of the tip of the tool, versus time, and graphical record of the withdrawal rate with respect to the drilling rate. This record shall be provided to the inspector at the end of each day's production, or less frequently if appropriate.

F. Additional standby grout equipment shall be maintained at the job site to prevent abandonment of piles if breakdowns occur.

G. AUTOMATIC MEASUREMENT AND RECORDING EQUIPMENT
1. The Contractor shall provide Automated Monitoring Equipment to provide automatic measurements during the pile construction process for test piles, reaction piles, and production piles as described below. The Contractor shall provide printouts on daily basis to the OAR's Geotechnical Engineer. As a minimum the following automatic measurements shall be made and recorded during the drilling operation:
   a. Auger rotation speed;
   b. Depth of the Auger injection Point;
   c. Auger torque, rotation, crowd and drilling rate;
2. All measurements shall be referenced to or plotted against the depth of the auger injection point. This shall be accomplished with a rotational position indicator on the auger head system and an electronic position indicator on the crane line or boom holding the auger. Torque and thrust load cells shall be positioned on the auger head system.
3. As a minimum, the following automatic measurements shall be made and recorded during the grouting operation versus depth:
   a. Volume of grout
   b. Grout pressure
   c. Auger rotation speed
   d. Depth of injection point
   e. Withdrawal rate
4. All measurements shall be referenced to or plotted against the depth of the auger injection point. This shall be accomplished with electronic flowmeters and electronic pressure transducers placed in the grout line, an electronic position indicator on the crane line or boom holding the auger, and a rotational position indicator on the auger system.
5. Calibration shall be made on all measuring and recording equipment at the beginning of the project that will demonstrate that the values indicated by the measuring and recording equipment are within 3 percent of the values indicated.
6. Calibrations shall be performed in accordance with the equipment manufacturer's specifications. All measuring and recording equipment shall also be recalibrated when the OAR's Geotechnical Engineer suspects that the drilling and grouting performance has changed.

PART 3 - EXECUTION

3.1 INSPECTION

A. The Pile Contractor shall examine the conditions under which piles are to be installed and shall notify the Contractor in writing of conditions detrimental to proper and timely completion of the work. The Pile Contractor shall not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to him. Notify the Architect/Engineer/ OAR's Geotechnical Engineer immediately by telephone when the grout level for any pile drops within 24 hours after installation.

B. OAR's Geotechnical Engineering Firm shall observe pile installation on a full-time basis.

3.2 PRE-AUGERING WORK:

A. Site Conditions: Do not auger piles until earthwork in area which piles are to occupy has been completed, as follows: (or as indicated on the drawings)

1. Excavations: The design intent is for the foundation excavation elevation to be within 12" above the average bottom of footing elevation. Earth excavation shall be one uniform elevation along the entire foundation site, for the purposes of installing the piles, as determined by the Contractor to minimize the length of pile installed. Should the Contractor deviate from this excavation elevation, the additional costs for extending pile vertical and confinement reinforcing (ties/stirrups) to meet the reinforcing bars locations at the top of pile elevation as detailed in the plans shall be borne by the Contractor.
2. Fills: Fills will be constructed and compacted to elevation of grade indicated on the drawings.

B. The Contractor shall develop a layout plan, referenced to the structural plans, which define a numbering system capable of identifying each pile individually. Pile locations shall be established by the Contractor, with the pile number and type, and working surface elevation indicated on a pin flag or stake.

C. Pile Length Markings: Mark pile lead with a horizontal line at 1'-0" intervals, and the number of feet from tip at 5'-0" intervals.

3.3 AUGER CAST DISPLACEMENT PILE EXCAVATION

A. Requirements:
1. Excavate holes for auger cast displacement piles to required bearing strata or elevation as shown on the drawings. Final auger cast displacement pile elevations different from those shown on the drawings will be paid for in accordance with contract conditions relative to changes in the work.
2. Adjacent auger cast displacement piles shall not be installed until the grout in any existing piles has attained its initial set to ensure that there will be no interconnection between piles. Sufficient distance based on the contractor means, methods, equipment, and experience with similar soils shall be maintained before installing new piles adjacent to piles that are less than 12

hours old. Typical spacing stated in the literature and case histories ranged from 6 to 12 times the pile diameter.

B. Drilling Tolerances:
   1. Location: Locate center of gravity of each single pile or pile groups within 3" from specified location.
   2. Plumbness: Piles shall not be out of plumb by more than 1.5% of length.
   3. Pile Cut-Off Elevation: Plus 0" to minus 2" above required top of pile elevations.
   4. Auger bit shall be within ½" of pile diameter.

C. Obstructions: If rocks, boulders, timbers, bricks, or other unforeseen obstructions are encountered during the drilling operation that causes auger refusal (penetration rate of the earth augering equipment less than one foot per minute), then such piles shall be completed to the refusal depth and paid for on the unit basis specified in the contract. Additional piles, if required, as determined by the OAR's Geotechnical Engineer, shall be added and paid for in accordance with the contract basis for changes in the work. Auger refusal assumes that adequate power, torque and down thrust are being applied and the penetration rate of at least one foot per minute cannot be achieved.

D. Over-excavation: No payment will be made for extra length of augercast piles when they are installed to a greater depth than required or as authorized by the OAR's Geotechnical Engineer.

E. Excavated Material:
   1. Remove excavated material and dispose of it as directed by the Owner.

3.4 GROUT PLACEMENT

A. All grout shall be ready-mix grout from a batch plant in accordance with the requirements of ASTM C94.

B. Grout pressure of approximately 20 psi should be maintained during the grouting state to ensure continuous pile shaft and minimize the risk of pile necking. If at any point, the required design positive grout pressure cannot be sustained, the tools shall be withdrawn at a rate to produce a grout factor of at least 130% until measurable grout pressure has been re-established. In case complete loss of grout pressure occurred (typically at shallow depths), a full grout head confirmed by overflow of the grout head from the hole should be established and maintained to the end of grouting stage.

C. The technique and equipment used to initiate and maintain the grout flow shall be such that a pile of the full design cross-section is obtained from the maximum depth of boring to the final pile cut-off level. The grout shall be supplied to the pile at a rate during auger withdrawal that ensures that a continuous monolithic shaft of at least the full specified cross-section is formed, and is free from soil inclusions or any grout or concrete segregation.

D. Stop grout placement at cut-off elevation shown, screed level, and apply a scoured, rough finish. Where cut-off elevation is above ground level, form top section above grade and extend pile, with proper reinforcing steel splices, as specified. Metal sleeves of the proper diameter and at least 18 inches in length shall be placed around the pile top to prevent contamination by foreign material.

E. The operation of augering and grouting shall be continuous and uninterrupted with grout pressure and volume at constant rates. If interruptions occur and continuity of pile in its full cross-section cannot be assured then the pile shall be abandoned at the discretion of the OAR's Geotechnical Engineer. Monitor and record grout pressure and volume at 5-feet intervals in addition to pressure monitoring data acquisition system.

F. The magnitude of grout volume factor for the site conditions shall be established during the test pile program and maintained during production pile construction. The volume of grout per linear foot of pile shall be not less than the volume of grout per foot of the approved installation test piles. All volume measurements shall be made in the presence of the OAR's Geotechnical Engineer or his representative.

G. Immediately upon completion of placement of the fluid grout, the Contractor shall remove all excess grout and spoil from the vicinity of the top of the excavation and place a suitable temporary device within the top of the excavation, extending both above and below the ground surface by at least 1 foot to keep surface spoil from entering the grout column before it sets. Immediately upon placement of this temporary device, the Contractor shall remove any and all loose soil that has fallen into the grout column by approved methods, and before the grout begins its initial set. The temporary device shall be removed without disturbing the natural soil surrounding the top of the pile once the grout has set.

H. Cease pile production immediately should monitoring equipment and instrumentation malfunction. The OAR's geotechnical engineer or his representative has the authority to stop installation of the production pile if communication of the hand-held pad and the rig is not maintained.

I. Hot Weather Placement: Grout shall not exceed a temperature of 100°F during mixing or pumping for a period not exceeding two hours. Protect grout from physical damage or reduced strength which could be caused by high temperatures in accordance with ACI 305.

J. Cold Weather Placement: Outside air temperature shall be 40°F and rising for the grouting operation unless special precautions, as approved by the OAR's Geotechnical Engineer, are maintained to keep the grout at 55°F or higher.

3.5 REINFORCING STEEL PLACEMENT

A. Before placing, clean reinforcing steel and dowels of loose rust, scale, dirt, grease, and other material which could reduce or destroy bond.

B. For piles with reinforcing cages specified, fabricate and erect cages as one continuous unit. Securely tie cage together with adequate ties and with interior cross ties as required to maintain proper shape. Provide cage with guiding devices between cage and pile circumference along the pile length to insure minimum 3" cover to cage. Detail such devices on the shop drawings. Work cages into final position without bar misplacement after grout is placed and still in a fluid state. Place top of reinforcing cage 2 inches below pile cut-off elevation within tolerance specified in ACI 117 (+/- 1/2 inch).

3.6 ACCEPTANCE OF PILES

A. Piles with Drop in Grout Level: If during the grout pumping process, the withdrawal of the auger becomes erratic, the grout pressure suddenly drops, or the grout flow is interrupted, the auger tip shall be re-inserted at least five (5) feet below the level where the grouting operation was disrupted prior to resuming withdrawal of the auger. Some subsidence of the fresh grout may occur at the top of the pile within a period of approximately one to two hours following the grouting operation, while the grout is plastic and workable. A pile grout subsidence of up to six (6) inches, within two hours of grouting operation, is considered acceptable. Piles that result in a drop of more than six (6) inches shall be abandoned unless tested and approved otherwise by the OAR's Geotechnical Engineer.

B. Damaged or Misplaced Piles: Damaged piles, piles with a drop in grout level, piles that communicated (grout water discharge) during installation, or piles placed outside specified tolerances will not be accepted. Such piles shall be reported to the Architect/Engineer as part of the pre-pile installation submittal. Cost of analysis for non-conforming piles shall be borne by the Pile Contractor.
   1. Abandon piles rejected after drilling and backfill hole if required with approved cohesionless soil, placed and compacted throughout the length. Replace with new piles as directed by the Architect/Engineer and the OAR's Geotechnical Engineer.
   2. Drill additional pile or piles where centerline tolerance is exceeded and analysis indicates the load on any pile exceeds 110% of design load, unless directed otherwise by the Architect/Engineer.

C. Piles that are required to be tested by the OAR's Geotechnical Engineer using post-installation integrity testing methods and are judged by the OAR's Geotechnical Engineer to be unacceptable shall be replaced at no additional cost to the owner.

D. Acceptance by the OAR's Geotechnical Engineer is required on all pile installation and his decision and judgment on pile length, rejection of piles, additional piles required, and all other pile installation and capacity questions shall be final. OAR's Geotechnical Engineer shall provide signed and sealed pile installation record reports, prior to commencing with the construction of a pile cap, indicating effective pile lengths, pile tip elevation, grout factor, calibration of grout volume per stroke for all pump(s) and equipment, reduced pile capacities (if applicable), and grout strength prepared by the OAR's Geotechnical Engineer along with the Contractor's Post-Construction Pile Survey to the EOR for review.

E. For piles to be accepted, they must at a minimum
   1. Have reached the plan tip elevation.
   2. Have maintained an adequate positive pressure throughout withdrawal, or the target oversupply was delivered through zones where pressure could not be sustained.
   3. EOR's official review, per pile cap, of OAR's Geotechnical Engineer signed and sealed pile installation records and Delegated Structural Engineer's pile group and pile cap analysis for non-conforming pile installation.
   4. There were no occurrences which, in the opinion of the OAR's Geotechnical Engineer, could be detrimental to the integrity of the pile.

F. Non-conforming piles: Where the pile is installed not in accordance with this specification the contractor has the option to engage a Delegated Engineer to perform analysis on the pile and design a pile cap to ensure the load capacity of the pile and cap system. Contractor to submit calculations signed and sealed by a registered professional engineer.

3.7 TEST PILE PROGRAM AND LOAD TEST

A. Perform load tests to verify design pile lengths and loads and optimize the pile design. Provide complete testing materials and equipment as required. Notify the Architect/Engineer 24 hours before performing tests and perform tests only in the presence of the OAR's Geotechnical Engineer.

B. Test piles (which are not load tested), furnished and installed by the Pile Contractor to determine pile criteria, may be located, cut off, and become part of foundation system provided they conform to contract requirements and are approved by the OAR's Geotechnical Engineer. Test piles which are load tested shall not be used as production piles.

C. Test Piles Required:
   1. Provide test piles as shown on the contract drawings or as directed by the OAR's Geotechnical Engineer.

D. Drilling Test Piles:
   1. Use test piles of same size and design as required for the project, and install with the same equipment as will be used in drilling permanent piles.
   2. Install test piles at locations and to the depths as specified by the OAR's Geotechnical Engineer.

E. Pile Design Load: Design load per pile is shown on drawings. However, this design load is subject to change by the OAR's Geotechnical Engineer depending on the results of the load test program.

F. Test Loads:
   1. The Pile Contractor shall provide a reaction and load application system capable of applying a compressive load of at least 3.0 times the design compressive load. The piles will be tested to failure or to three times the

allowable capacity as shown on the drawings to optimize the pile design, hence, the reaction system shall be design and provided by the contractor.

G. Pile Load Testing: Pile load tests shall be at a location as determined by the OAR's Geotechnical Engineer and approved by the Architect/Engineer. Test shall be performed under the supervision of the OAR's Geotechnical Engineer. Costs of load tests shall be borne by the Pile Contractor. Design of the load test frame shall be the responsibility of the Pile Contractor. Shop drawings of the load test frame shall be submitted for Architect/Engineer review and shall be prepared under the supervision of and sealed by a professional engineer licensed in Florida. Load and test piles which have been in place sufficient time to allow compressive testing of the 7 day grout samples. Once the design compressive strength is achieved, load testing may proceed at that time. Additional time and testing may be required to attain sufficient concrete compressive strength. Determine the load-settlement relationship of test piles under a vertical axial load, complying with ASTM D 1143 (Quick Load Test Method for Individual Piles), ASTM D3689, and ASTM D3966.
   1. Loading shall be continued until the deflection of the butt exceeds 1.5 inches or until the capacity of the load application system is reached.
   2. Ultimate load shall be defined as the lesser of 1) the load at which the load-deflection relationship exceeds a slope of 0.02 inches per ton, or 2) the load at which the pile butt deflection exceeds 6 percent of the pile diameter. The allowable load shall be computed as 0.5 times the ultimate load, except that the pile butt movement at the allowable load shall not exceed 0.3 inches. Final allowable load based on the pile testing program should be recommended by the OAR's Geotechnical Engineer.

H. Test Reports:
   1. Prepare reports for each test pile and include: Date of installation, test pile location, size and length of pile, grout compressive strength, tip elevation, surface elevation, theoretical and actual volume of grout, reinforcing steel size and depth placed, drilling start and finish time, grouting start and finish time, amount of drop in grout level in 24 hours, and any unusual circumstances affecting pile performance.
   2. Include with the report a record of drilling equipment used.
   3. Also include tabular and graphical representation of gross and net settlement of the pile top, relationship of actual load capacity to that predicted, and any recommendations for production pile installation.

3.8 FIELD QUALITY CONTROL

A. The Owner will engaged a testing agency and Geotechnical Engineer to sample materials, perform tests and obtain measurement during the pile installation.

B. Sampling and testing of grout will include flow cone tests (ASTM C939), temperature (ASTM C 1064) and compressive strength tests on 2 inch cubical grout specimens (ASTM C 109).

C. At least one set of six grout cubes shall be made for each fifty cubic yards of grout placed. At least one set of specimens shall be cast for each day of installation.

Compressive strength specimens shall be tested as follows: one at seven days, two at fourteen days, two at twenty-eight days, and one held.

D. If the break result of any 7-day specimen is less than 75% of the design strength in 28 days, then the OAR's Geotechnical Engineer shall immediately phone the Pile Contractor to confirm proper notification.

E. Strength level of grout will be considered satisfactory if averages of sets of 3 consecutive strength test results (the average of two individual strength breaks equals one strength test) equal or exceed the specified compressive strength and no individual strength test result falls below the specified compressive strength by more than 500 psi.

F. Pile Integrity Testing

1. Per the recommendations of the OAR's Geotechnical Engineer, Pile Integrity Testing (PIT) may be requested to inspect the actual installed piles in order to determine the overall integrity of the top 40 to 45 feet. The results shall be analyzed by a Pile Integrity Testing (PIT) Consultant as indicated in paragraph "PIT Consultant" using an approved commercial software package designed by the PIT manufacturer, Pile Dynamics, Inc. or approved equivalent. PIT testing is a Non-Destructive integrity test method for foundation piles.
2. It is a "Low Strain" Method (since it requires the impact of only a small hand-held hammer). The evaluation of PIT records is conducted either according to the Pulse-Echo (or Sonic Echo - a time domain analysis) or the Transient Response (frequency domain analysis) Procedure. In general, the test requires the impact of a small hand held hammer on the shaft top and the measurement of the shaft top motion (acceleration or velocity). The input compression wave from the hammer is reflected from pile toe (or a defect) and returns to the pile top at a time related to the speed of travel of the wave in the pile material.
3. Pile integrity tests shall be performed using digital data acquisition equipment. The signal conditioning and power supply must have very high signal-to-noise ratios since the reflected signals for long piles (and/or piles in high friction soils) are often very weak. The analog to digital resolution shall be at least 16 bits, and the sampling frequency at least 40,000 Hz. Data should be stored such that additional processing or further wave analysis is possible. The data must be displayed in the field for evaluations of preliminary data quality and interpretation.
    a. The Pile integrity testing consultant shall consist of personnel independent of the Auger Cast Pile Contractor and Prime Contractor, paid for by the **Contractor**. The field testing shall be performed by a technician with at least three years of experience in pile integrity testing. The interpretation of the records shall be completed by a professional engineer licensed in the state of Florida with at least five years of experience in integrity testing interpretation.

    b. Integrity testing shall not be performed until the concrete has cured for a minimum of seven (7) days and obtained a minimum of 3000 psi compressive strength, whichever is greater. The pile head shall be free

from water, dirt or other debris. The concrete at the pile top surface must be relatively smooth with sufficient space for both attachment of the motion sensing device and hammer impact area.

c. 100 percent of the first 20 piles shall be integrity tested. Integrity testing shall proceed concurrent with pile installation operations to verify the installation techniques and to ensure that the piles installed are not defective. Should any of the tested piles prove defective, as determined by the OAR's Geotechnical Engineer, the Contractor shall identify the cause(s) and make appropriate adjustments to his construction techniques to prevent a similar occurrence. Where defective piles are found in the testing of the first 20 piles, the Contractor, at his expense, shall continue to test each pile on the project until he can show that his methods are producing satisfactory defect free results.

d. Providing the first 20 piles tested are determined to be satisfactory by the OAR's Geotechnical Engineer, the **Contractor, at his expense**, shall test 1 per each group of 20 piles completed for the remainder of the project, at locations determined by the OAR's Geotechnical Engineer, so long as the test results remain satisfactory. Should the continued testing reveal any defective piles, testing shall revert to 100 percent until satisfactory results are achieved as determined by the OAR's Geotechnical Engineer. The contractor shall ensure that no construction obstructing access to the piles occurs until after testing is completed and then evaluated by the OAR's Geotechnical Engineer.

e. PIT records shall be submitted within 24 hours of performing the field test and shall include test results and integrity evaluation. For each pile tested, the averaged, amplified velocity versus time record shall be included in the report, with a table summarizing results and conclusions.

In addition, a final report to include the testing of all piles shall be submitted with 14 days after all testing is completed.

f. Piles with no significant reflections from locations above the pile toe and with a clear pile toe reflection may be accepted. Where no clear toe reflection is apparent, the experienced test engineer shall state to which shaft depth the test appears to be conclusive. Where reflections from locations with significant reductions above the pile toe are observed, the pile has a serious defect. If the record is complex, the results may be deemed inconclusive. Construction records (concrete usage, grout pressure records, soil borings) may be valuable in result interpretations or additional numerical analysis modeling may be used to quantify the record. The decision to reject and replace, or repair, any defective shaft is at the sole responsibility of the OAR's Geotechnical Engineer.

3.9 CONTRACT BASIS

A. Basis for Bids: Bids will be based on the number, size, and length of piles shown on the drawings from tip to top of grout.

B. Basis for Payment:

1. The Contractor and the OAR's Geotechnical Engineer shall calculate the actual total length of piles installed on the job. The contract price per lineal foot shall include all labor, materials, tools, equipment, and incidentals, and for performing work for furnishing, drilling, cutting off, capping all piles, and testing.
2. Measurements of pile lengths shall be based on effective length of acceptable piles in place with fractional lengths measured to the nearest foot. Payment for lineal footage in excess of that indicated in the bid and credit for lineal footage less than that indicated in the bid, shall be made at unit prices stated in the contract. Note that payment will be based on lengths of all the piles on the job added together for application of the unit prices and not lengths on a per pile basis.
3. Based upon observations during installation of test piles, a minimum volume of grout per linear foot of pile and grout volume factor will be determined. The OAR's Geotechnical Engineer shall have the right to increase or decrease the volume of grout per linear foot of pile and to increase or decrease the total grout volumes required by changing pile locations or elevations, requiring the installations of additional piles, or directing the omission of piles from the requirements shown or specified. Pile grout volume will be measured for payment on the basis of the total grout volume of piles, exclusive of load test reaction piles, satisfactorily installed in place from the ground surface to final tip elevations as directed by the Contracting Officer. Actual grout volume measurements will be recorded on a per linear foot basis in the presence of the OAR's Geotechnical Engineer or his representative based on a calibration of grout volume vs pump strokes prior to the installation load test pile program. No payment will be made for withdrawn, damaged, or rejected piles; nor for any additional grout volume caused by wasted grout, excessive grout head or other unsatisfactory installation techniques by the Contractor as determined by the OAR's Geotechnical Engineer. Excessive grout head is defined as "when grout is observed coming out of the pile during pumping, prior to the last 10 feet of installation". Payment will be made for satisfactorily installed pile lengths at the contract unit price per cubic foot, which shall include payment for furnishing and installing grout and all other work incidental thereto, exclusive of that work covered under the payment item for pile lengths.
4. Test piles that are not load tested shall become part of completed foundation work will be considered as an integral part of the work.
5. Payment will be made for each satisfactorily completed test program at the contract unit price per test. Each axial compressive test program shall include installation of a test pile of hereinafter specified length and necessary reaction piles, auger withdrawals of 2 reaction piles per load test, and the furnishing, delivering, handling, and/or installing, as applicable, all labor, materials, equipment and instrumentation, as well as survey and professional engineer services necessary to support the test pile installation and procedure applicable to conducting, monitoring and recording data for the axial compressive load test to the required load or pile failure. No payment will be made for test programs which were unsatisfactorily performed, as determined by the OAR's Geotechnical Engineer.

6. All costs associated with Pile Integrity Testing will be paid for at the contract lump-sum price, which shall include furnishing all labor, equipment, materials, and supplies, and performing all testing, interpretations and reports specified herein, directed by the OAR's Geotechnical Engineer, or are otherwise required to satisfactorily complete the work.
7. No payment will be made for piles rejected for any reason including but not limited to piles placed out of specified tolerances, imperfect piles, piles that had a drop in grout level, piles with grout strength less than specified, misplaced or omitted reinforcing steel, and insufficient drilled length from that specified.

END OF SECTION 31 6316

SECTION 31 6400.13 – LOW MOBILITY PRESSURE GROUTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Information concerning a sub-surface soil investigation by an independent testing laboratory is available and will be furnished by the Owner upon request. The data included therein may be used by the Contractor for his general information only. The Architect/Engineer will not be responsible for the accuracy or applicability of the data therein.

C. These specifications were prepared to assist the remediation contractor and should be viewed along with the contractor's Stabilization Plan which details the locations and quantity of grout points at the subject site.

D. They are intended only for use in the remediation of the subject site for the aforementioned report. Soil boring logs included in the aforementioned report only represent the subsurface conditions encountered at the locations of the individual borings.

E. Subsurface conditions between the completed borings are likely to vary and soil conditions presented are intended to be used for estimation purposes only.

F. The grouting program may be changed by the Engineer as dictated by the actual conditions encountered in the field. Any changes to the number, location, and minimum or maximum depth of the grout points must be at the discretion and approval of the OAR's Geotechnical Engineer.

G. The Engineer shall have a representative on site at all times during grout operations. The OAR's Geotechnical Engineer or his representative shall observe the grout pumping operations and provide a geotechnical report at the end of the project detailing the locations of the grout points installed, the amount of grout installed, and a professional opinion as to whether or not the plans and specifications were sufficiently followed by the grouting contractor.

1.2 SCOPE OF WORK

A. The grouting contractor shall be responsible for providing the labor, materials, equipment, and supervision to accomplish the scope of work at the locations and depths specified herein and shown on the drawings.

B. Provide the Engineer with a detailed work plan describing the intended

procedures for drilling the grout points, placement of the grout, surveying of the surrounding ground during grout placement, types of equipment and instrumentation to be used, grout mix design, and schedule for completing the work. All work schedules shall be approved by the Engineer prior to the start of work.

C. Attend a pre-drilling meeting at the site with the OAR's Geotechnical Engineer or his representative. Pre-drilling meeting will address actual grout point locations. It will also serve as an opportunity for the grouting contractor to request changes to the grout plan or have questions answered about these specifications. Pre-drilling meeting may be on the first day of intended drilling if so desired but must be completed prior to any drilling at the site.

D. Install the grout points at the locations and depths provided in **contractor's Stabilization Plan** and these specifications with any changes made by the Engineer during the course of the project.

E. Pump grout into the grout points according to these specifications. Monitor and record; grout pressures, ground movements during pumping, depth of each grout point at each pumping interval, and reasons for raising grout points during pumping. Documentation of amount of grout pumped, grout truck tickets, and amount of grout placed into each grout point will be provided to the OAR's Geotechnical Engineer or his representative daily.

F. Remove all grout pipe, equipment, and materials, fill in open grout point holes, and cleanup of site.

1.3 QUALIFICATIONS

A. The compaction grouting program, including installation of grout pipes, shall be performed by a specialist grouting contractor with at least five continuous years of documented experience in compaction grouting.

B. The grouting contractor shall provide experienced management, supervisory and key personnel to implement the compaction grouting program, as follows:
   1. The project manager shall have at least five years of continuous experience in compaction grouting.
   2. The superintendent shall have at least five years of experience in compaction grouting.
   3. The grouting contractor shall provide:
      a. Evidence of previous compaction grouting project experience.
      b. Evidence of management, supervisory and key personnel experience.

1.4 QUALITY ASSURANCE

A. The Contractor is responsible for quality control, including workmanship and materials furnished by his subcontractors and suppliers.

B. The Contractor shall comply with all provisions of the local building code and all other applicable codes and standards.

1.5. SUBMITTALS:

A. Submit a list of at least five previously completed projects of similar scope and purpose for approval by the Engineer. The list shall include a description of the project, relative size, and contact person with phone number.

B. Resume of the management, supervisory, and key personnel, for approval by the OAR's Geotechnical Engineer.

C. The Contractor shall provide detail method of installation.

D. The contractor shall be responsible for monitoring and submitting to the OAR's Geotechnical Engineer the following information:
   1. Prior to start of the job:
      a. A detailed work plan describing the intended procedures for drilling the grout points, placement of the grout, surveying of the surrounding ground and structures during grout placement
      b. A list of equipment and instrumentation to be used including grout pump model information and grout pipe specifications.
      c. The grout mix design and proposed grout supplier.
      d. A schedule for completing the work.

   2. Daily reports during the job shall consist of:

      a. Grout truck tickets showing mix design name, design slump, and provider.
      b. Daily records shall be available to the OAR's Geotechnical Engineer by request for comparison to engineer's records and shall consist of at least amount of grout pumped into each grout point on a daily basis, ground movements during pumping, depths of each grout points at each pumping interval, and reasons for raising grout points during pumping.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Portland Cement (ASTM C150).

B. The grout materials will consist of a combination of Portland cement, fine aggregate and water.

C. Additives may be used, provided the grout mixture meets slump requirements. Hydro-active and micro-fine grouts are acceptable.

D. Fine aggregates will consist of hard, clean, strong, durable and uncoated particles, in accordance with ASTM C144-76. The fine aggregate will have a fines content of not less than 10 percent with not more than 30 percent passing the No. 200 sieve.

E. The gradation of the mix will be such that sand blocking does not occur at the grout working pressures specified.

F. The grout mix will have a target slump of 3-inches ± 1 inch as measured at the truck including any additives or water added by the driver.

G. If the hose length exceeds 50 feet, the slump can be measured at the end of the hose.

H. Grout with a slump greater than 4 inches shall be rejected by the contractor.

I. The OAR's Geotechnical Engineer shall observe slump tests by the contractor, and when necessary, perform verification tests and/or spot checks as desired by the engineer.

J. No grout shall be pumped more than 4 hours after the batch time shown on the delivery ticket.

K. The grout mix design shall have a 28-day compressive strength of at least 300 psi.

L. Water shall not be added without notification of the Engineer or their representative. Water used in the grout will be free of deleterious and organic material.

M. No admixture will be used without the OAR's Geotechnical Engineer prior approval.

N. Upon discharge into the pump hopper or holding tank, the grout must be continuously agitated. Mixed grout may not be held in the agitator for more than 1.5 hours unless a set retarder, approved by the OAR's Geotechnical Engineer, is used.

2.2 EQUIPMENT

A. The grouting contractor shall supply equipment capable of advancing the grout pipe through overburden soils and other natural obstructions to the specified depth or as is required to meet the project objectives.

B. The grout contractor shall supply all equipment required to operate a grouting system capable of supplying the grout at variable flow rates and pressures as required to suit the application.

C. The mixer shall be a continuous auger type to ensure complete uniform mixing of the materials used and shall be of sufficient capacity to continuously provide the pumping unit with mixed grout at its normal pumping range. Ready mixed grout is also acceptable with an approved mix design.

D. Grout pipes shall be placed with a drill rig sufficient to advance the approved grout pipes.

E. Pipes shall be installed such that grout material will not travel in the annular space between the pipe and adjacent ground and escape at the surface when pumped

F. The grout pump shall be a continuous flow, positive displacement pump capable of pumping cement grout with a slump of 3 to 4 inches maximum at a pressure of up to 600 psi.

G. Grout injection pipes shall be flush threaded steel pipe, inside diameter of 3-inches ± ¼ inch, of sufficient strength to maintain the hole and to withstand the required jacking and pumping pressures. It shall be the contractor's responsibility to install casing that does not detrimentally impact the grouting procedure.

H. Provide pressure gauge capable of reading pressures up to 600 psi at increments of 25 psi or smaller shall be placed in-line as close as possible to the top of the grout pipe casing.

I. Provide additional gages and instrument (measuring devices) as directed by OAR's Geotechnical Engineer to measure:
   1. Continuous grout pressure
   2. Flow rate of grout
   3. Volume or grout injected.

J. An adequate communication system shall be maintained between the pumping and batching plant and the injection location. As an alternate, the contractor may furnish a remote control system to allow full control (start, stop, flow rate, reversing) of the pump directly by the grouting technical from the injection point.

PART 3 - EXECUTION

3.1 INSPECTION

A. The Contractor shall examine the site conditions and shall notify the OAR's Geotechnical Engineer in writing of conditions detrimental to proper and timely completion of the work. The Contractor shall not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to him/her.

B. Compaction grouting shall be performed in accordance with the provided grout injection point layout scheme and as directed by the OAR's Geotechnical Engineer.

C. The Compaction grouting should start at the bottom of the soft deposits at elevation about -70.00 feet deep and continue upward to the recommended pile tip elevation of +5.00 to ensure uniform bearing soil.

3.2 GROUT PIPE INSTALLATION

A. Grout pipes shall be placed at the locations shown on **contractor's Stabilization Plan** or at the modified locations dictated by the Engineer.

B. They shall be advanced to the bottom of the soft deposits at elevation about -70.00 feet deep and continue upward to the recommended pile tip elevation +5.00 to ensure uniform bearing soil.

C. The casing will be installed such that there is sufficient contact with the drilled hole in order to prevent grout leakage and/or premature upward movement of the casing during injection of high-pressure compaction grout.

D. Any deviations of greater than 2 feet from plan position shall be approved by the OAR's Geotechnical Engineer prior to installation

3.3 GROUT INJECTION

A. The contractor is not required to drill every grout point prior to beginning grout injection. Unless otherwise directed by the OAR's Geotechnical Engineer, grouting shall begin at the deepest vertical point

B. Grouting pressure will be continuously monitored with a pressure gauge placed in the grout line as close as possible of the top of the grout pipe casing

C. Controlled grout pumping rates of 2 to 5 cubic feet per minute will be required. Grout quantities will be monitored and recorded on a continuous basis.

D. Grout will be injected on a continuous basis throughout the depth of the grout point with the grout casing being withdrawn in increments of 5 feet or less. The criteria for raising the grout pipe to the next increment will be when one of the following occurs:
   1. The grout pressure at the gauge located close to the head of the grout pipe casing exceeds **200 psi over the necessary pressure to initiate grout take, provided there is no blockage of the pipe**.
   2. If the grout take exceeds 5 cubic yards in a five-foot interval, the injection point shall be raised no more than 5 feet and flushed, and the initial (injected) amount of grout shall be allowed to set. Subsequently, the grout injection may be resumed the next day.
   3. When ground surface heave occurs.

4. Excessive tightness of grout pipe as a result of constriction from the injected grout is observed.
5. Backpressure causing grout to emerge from the top of the pipe or around the base of the pipe is observed.
6. Uplift of grout pipe resulting from ground pressure occurs.
7. If grouting is to be terminated at the end of day or the end of a truck with no additional trucks waiting, the grout point may be raised no more than 5 feet and flushed to clear the lines until grouting can be resumed. If grout is observed to backflow into the pipe after flushing, the pipe may be raised as necessary to prevent grout from setting up in the casing, however the grout point must be re-drilled to the previous grout depth prior to resuming grouting.
8. When adjacent grout points are deemed to have required an excessive amount of grout by the Engineer, an additional grout point may be placed between the previously completed grout points as the OAR's Geotechnical Engineer sees fit.

E. As compaction grouting is completed at each location, the grouting contractor shall completely fill the grout hole to the ground surface.

3.4 FIELD QUALITY CONTROL

A. All grouting shall be performed under the inspection of the OAR's Geotechnical Engineer.

B. Monitoring and logging of compaction grouting operations shall be done by the OAR's Geotechnical Engineer.

C. Contractor to perform slump tests of grout and take measurements of grout mix quantities to verify the grouting contractor's grout mix, as follows:

1. Slump tests:

a. once for every100 cubic ft of grout injected, or
b. at any change in mix design, or
c. at least twice during each grout shift

2. Grout mix proportions will be checked at least once daily.

D. The grouting contractor to cast minimum size 3 inch by 6 inch grout test cylinders or 2 inch by 2 inch cube molds for strength testing. One set of four cylinders or molds will be casted during each slump test.

3.5 CONTRACT BASIS

A. Basis for Bids: Bids will be based on the areas shown within the contract drawings along with the information provided above.

B. Basis for Payment:

1. The Contractor and the OAR's Geotechnical Engineer shall coordinate the actual installation of pipes and the volume of grout installed. The contract price per volume of grout shall include all labor, materials, tools, equipment, incidentals, and testing as described within this specification.
2. Grout volume will be measured for payment on the basis of the total grout volume. Actual grout volume measurements will be recorded continuously in the presence of the OAR's Geotechnical Engineer or his representative. No payment will be made for any additional grout volume caused by unsatisfactory installation techniques by the Contractor as determined by the OAR's Geotechnical Engineer. Payment will be made for satisfactorily installed grout at the contract unit price per cubic foot, which shall include payment for furnishing and installing grout and all other work incidental as stated above.

3.6 LIMITATIONS

A. The contractor shall exercise care when grouting beneath and adjacent to any existing utilities. The contractor is responsible for ensuring the grouting operation does not damage any utilities, wells, etc.
B. The OAR's Geotechnical Engineer or his representative shall not direct the daily work flow but shall merely verify that the contractor is acting within the specifications for the project.
C. The OAR's Geotechnical Engineer or his representative may however stop the grouting operation at any time if in his or her judgment the operation does not comply with the specifications of if the work is unsatisfactory.
D. The OAR's Geotechnical Engineer may change the location, number, and depth of the grout points to suit the conditions encountered as necessary.
E. The Contractor or Specialty Contractor shall be responsible for obtaining any State and municipal permits (if required) and conforming to all State and local regulations.
F. The Contractor will be responsible for the precise delineation of all above and below ground utilities and obstructions.

END OF SECTION 31 6400.137~~000~~

SECTION 32 13 15 - CONCRETE PAVING FOR LANDSCAPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Sidewalks
   2. Concrete Pavement

1.3 REFERENCES

A. ACI 117 - Tolerances for Concrete Construction and Materials.
B. ACI 301 - Specifications for Structural Concrete for Buildings
C. ACI 302 - Recommended Practices for Concrete Floor and Slab Construction.
D. ACI 304R - Guide for Measuring, Mixing, Transporting and Placing Concrete
E. ACI 305R - Hot Weather Concreting
F. ACI 306R - Cold Weather Concreting
G. ACI 308 - Standard Practices for Curing Concrete
H. ACI 347 - Guide to Formwork for Concrete
I. ASTM A 497 - Standard Specification for Welded Wire Reinforcement for Concrete
K. ASTM C 31 - Making and Curing Concrete Test Specimens
L. ASTM C 33 - Standard Specification for Concrete Aggregates
M. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
N. ASTM C 94 - Standard Specification for Ready-Mixed Concrete
O. ASTM C 150 - Standard Specification for Portland Cement
P. ASTM C 171 - Sheet Materials for Curing Concrete
Q. ASTM C 309 - Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete
R. ASTM C 494 - Standard Specification for Chemical Admixtures for Concrete

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 ACTION SUBMITTALS

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

B. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

C. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color selection.

D. Other Action Submittals:

1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified ready-mix concrete manufacturer and testing agency.

B. Sustainable Design Documentation Submittals: Refer to Section 01 81 13.14 “Sustainable Design Requirements – LEED v4 BD+C

1. Product Data: Documentation for Leadership Extraction Practices in the following:

a. Regional/Local Multiplier Compliance

b. Leadership Extraction Practices for Recycled Content.

2. Product Certificates: Provide the following:

a. Environmental Product Declarations (EPD’s)

b. Corporate Sustainability Reporting (CSR’s)

C. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer plus one-half of pre-consumer recycled content is not less than 25%

D. Material Test Reports: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of pre-consumer recycled content is not less than 10%

E. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Detectable Warning Installer Qualifications: An employer of workers trained and approved by manufacturer of stamped concrete paving systems.

B. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

C. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

D. Concrete Testing Service: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures.

E. ACI Publications: Comply with ACI 301 unless otherwise indicated.

F. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Construct each sample using products, materials and methods identical to those to be used in the finished work. Concrete used for samples shall be of the same approved mix design, including source, admixtures and batching procedures to be used in the finished work.

a. Finishers and foreman that execute the approved mock-ups shall be the same workmen who execute the finished work.

b. Include in each sample all joint types, which will occur in the finish work.

c. Include in the finishing of any formed surfaces, patching and repairing of major and minor defects.

d. Include in each sample all specific aggregate types and sizes that may be specified on the drawings or present within the owner’s sample.

e. Cure, harden and seal all mock-ups with materials and methods specified for the finished work.

2. Cast and finish samples at a location approved by Owner.

3. Approved Mock-ups and Sample Panels will be used to judge final acceptance of the finished work. Contractor will be responsible to relocate samples adjacent to the final work for reference when requested by Owner. For this purpose, samples are to be constructed in a manner that will allow for them to be moved without damage.

4. Obtain Owner's approval of each mock-up prior to commencement of final work. If first samples are not approved, prepare additional mock-ups until approval is obtained.

5. Build mockups of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship.

6. Build mockups of concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Architect and not less than 6 feet by 6 feet. Build mockup of full-size detectable warning strip.

7. Retain first subparagraph below if mockups are not only for establishing appearance

8. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

9. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

G. Pre-installation Conference: Conduct conference at Project site.

1. Review methods and procedures related to concrete paving, including but not limited to, the following:

   a. Concrete mixture design.
   b. Quality control of concrete materials and concrete paving construction practices.

2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:

   a. Contractor's superintendent.
   b. Independent testing agency responsible for concrete design mixtures.
   c. Ready-mix concrete manufacturer.
   d. Concrete paving subcontractor.
   e. Manufacturer's representative of stamped concrete paving system used for detectable warnings.

1.7 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 -PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

2.2 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

B. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.

C. Reinforcing Bars: ASTM A 615, Grade 60; deformed.

D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice."

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use one of the following cementitious materials, of the same type, brand, and source throughout the Project:

1. Portland Cement: ASTM C 150, white and gray, Type I or II.

B. Normal-Weight Aggregates: ASTM C 33, locally available coarse aggregate, uniformly graded. Provide aggregates from a single source.

C. Stone Aggregate: Match Architect’s samples.

D. Water: ASTM C 94.

E. Air-Entraining Admixture: ASTM C 260.

F. Chemical Admixtures: ASTM C 494, of type suitable for application, certified by manufacturer to be compatible with other admixtures and to contain no more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

2.4 CURING MATERIALS

A. Water: Potable.

B. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to

fresh concrete.

C. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

2.5 RELATED MATERIALS

A. Expansion-and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

2.6 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, with the following properties:

1. Compressive Strength (28 Days): 3500 psi.
2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.40.
3. Slump Limit: 4 inches, plus or minus 1 inch.
4. Air Content: 5-1/2 percent plus or minus 1.5 percent.

B. Provide white and gray concrete for areas indicated.

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Furnish batch certificates for each batch discharged and used in the Work.

PART 3 -EXECUTION

3.1 EXAMINATION

A. Proof-roll prepared sub-base surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.

3.2 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.3 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

3.4 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints, as indicated.

C. Expansion (Isolation) Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated. Expansion Joints shall be constructed as follows:

1. Provide foam or rigid joint filler material as required to the full depth of the slab. Note: non-removable plastic joint strips will not be allowed for the installation of any expansion or isolation joints.

2. Unless otherwise directed by owner, provide a 1/4 in. radius, tooled edge, for all expansion joints and paving edges.

D. Control (Contraction) Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness. Control Joints shall be constructed using a saw to cut the joints as follows:

1. Make saw-cut control joints in concrete no later than 12 hours after finishing or as soon as concrete is strong enough to not be damaged by the blade or weight of the machine.

2. Carefully check condition of concrete before commencing saw-cutting to ensure that the saw will not fret, ravel, spall edges of cuts or dislodge aggregate. Use saw-cutting equipment appropriate for hardness of the concrete.

3. Depth of saw-cuts shall be no less than 1/4 of the installed slab thickness. Do not cut through steel bar reinforcing. Saw-cuts to be 1/8 in. wide unless otherwise noted on Drawings.

E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 3/8-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

3.5 CONCRETE PLACEMENT

A. Moisten sub-base to provide a uniform dampened condition at time concrete is placed.

B. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

C. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

D. Screed pavement surfaces with a straightedge and strike off.

E. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

3.6 FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Sponge Float Finish:

1. Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

2. Sponge float is a rougher finish than a Smooth float finish, achieved by final troweling with a sponge or rubber faced float leaving a pronounced radial trowel pattern. Landscape Architect will provide art direction for desired pattern.

C. Broom Finish:

1. Brush or broom finish is achieved by drawing a clean stiff-bristle broom across the still-plastic surface to create uniform striations. Direction of broom pattern is to be alternated between each adjoining panel. However, the pattern may be otherwise directed by owner.

2. Medium Broom; executed with medium to stiff Palmyra bristle push broom.

3.7 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with ACI 301 for hot-weather protection during curing.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb./sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

D. All concrete shall be properly cured with approved methods and materials as specified.

1. Commence curing of concrete immediately after finishing is completed. Do not permit any traffic, debris or material storage on surfaces during curing.

2. Alternating wet and dry surface conditions during curing are not permitted.

E. Natural Gray Concrete: Cure standard gray flat work with liquid applied curing compound and curing blankets or by water-curing methods as follows:

1. Curing Compound method:

a. Immediately after finishing concrete, apply two separate and overlapping applications of curing compound at opposing right angles.

b. Cover with approved curing blankets. Lap joints 12 in. and seal with a water-resistant, pressure-sensitive tape. Seal perimeter edges and penetrations to slab to prevent loss of moisture.

c. Maintain blankets in-place for a minimum of 14 days.

2. Water-curing method:

a. Maintain concrete surfaces continuously wet for 14 days by either ponding with water, using a constructed dam around the perimeter or by applying a continuous fine spray of potable water.

3.8 JOINT SEALANT

A. Conform to ACI 504, ASTM C1193 and sealant manufacturer’s recommendations.

1. Clean joints with wire brush and air blasting or vacuum. Insure that all dirt and loose materials are thoroughly removed joints and surrounding area prior to installing sealant.

2. Mask or otherwise protect adjacent surfaces from sealant materials.

3. Install foam backer rod to proper depth. Joint width-depth ratio shall comply with sealant manufacturer’s recommendations.

4. Install sealant material by pouring or gunning directly in joints. Neatly tool to eliminate air pockets and voids and to provide a smooth finish.

5. Protect all joints from dirt, debris and all pedestrian and vehicular traffic until it has been properly cured.

6. All products are to meet the criteria for Sustainable Design Requirements LEED v4 BD+C. Refer to Section 01 8113.14.

3.9 REPAIRS AND PROTECTION

A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.

B. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement.

C. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than one day before date scheduled for Substantial Completion review.

END OF SECTION

SECTION 32 13 73 - CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Products to meet Sustainable Design Requirements of LEEDv4 BD+C. Refer to Section 01 8113.14.

1.2 SUMMARY

A. Section Includes:

1. Cold-applied joint sealants.

B. Related Sections:

1. Division 32 Section "Concrete Paving" for constructing joints in concrete pavement.

1.3 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

C. Pavement-Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

D. Qualification Data: For qualified Installer.

E. Product Certificates: For each type of joint sealant and accessory, from manufacturer.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for joint sealants.

G. Preconstruction Compatibility and Adhesion Test Reports: From joint-sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility with and adhesion to joint sealants.

2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain each type of joint sealant from single source from single manufacturer.

C. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

1.5 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Landscape Architect from manufacturer's full range.

2.2 COLD-APPLIED JOINT SEALANTS

A. Single-Component, Nonsag, Silicone Joint Sealant for Concrete: ASTM D 5893, Type NS.

B. Single-Component, Self-Leveling, Silicone Joint Sealant for Concrete: ASTM D 5893, Type SL.

C. Multicomponent, Pourable, Traffic-Grade, Urethane Joint Sealant for Concrete: ASTM C 920, Type M, Grade P, Class 25, for Use T.

2.3 JOINT-SEALANT BACKER MATERIALS

A. General: Provide joint-sealant backer materials that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.

B. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

C. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D 5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.

D. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D 5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

2.4 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

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

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.

B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install joint-sealant backings of kind indicated to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of joint-sealant backings.
2. Do not stretch, twist, puncture, or tear joint-sealant backings.
3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install joint sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place joint sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:

1. Remove excess joint sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

3.4 CLEANING

A. Clean off excess joint sealant or sealant smears adjacent to joints as the Work progresses, by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

B. Refer to Section 01 7423 Final Cleaning for al final cleaning.

3.5 PROTECTION

A. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

END OF SECTION

SECTION 32 14 00 - UNIT PAVERS

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 SECTION INCLUDES

A. Concrete Pavers:

1. Setting: Thin-set mortar.
2. Setting: Portland cement mortar.
3. Setting: Bituminous.
4. Setting: Open joints and pedestals.
5. Setting: Sand.

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM C 33 - Specification for Concrete Aggregates.
2. ASTM C 150 - Specification for Portland Cement.
3. ASTM C 1260 - Method of Sampling and Testing Brick and Structural Clay Tile.
4. ASTM C 140 - Specification for Concrete.

B. Tile Council of America (TCA):

1. TCA F102 - Installation Method Cement Mortar Bonded.
2. TCA F101 - Installation Method Cement Mortar Bonded.

C. American National Standards Institute (ANSI):

1. ANSI A-118.4 - Latex Portland Cement Mortar.
2. ANSI A-118.6 - Grout - Latex.

1.4 SUBMITTALS

A. ~~——~~ ___Submit under ~~provisions~~Provisions of Section ~~01300.~~013323

B. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Test Reports: Three copies, showing compliance with specified ASTM requirements.
2. Preparation instructions and recommendations.
3. Storage and handling requirements and recommendations.

4. Installation methods.

C. LEED Submittals:

1. Refer to Section 01 ~~8113~~81 13.14 for requirements on Sustainable Design Requirements for LEEDv4 BD+C.

2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material~~.~~ shall be supplied. Include statement indicating distance to Project is within 100 miles, cost for each regional material, and fraction by weight that is considered regional.

D. Shop Drawings:

1. Layout drawings of each paved area showing the pattern of pavers, indicate pavers requiring cutting, indicate setting bed methods in each area, drainage patterns and drains. Include details of setting beds, noting all materials and their thickness, show details at curbs and vertical surfaces.
2. Details of custom (nonstandard) curbs and stair tread/risers, include methods of installation.

E. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

F. Verification Samples: For each finish product specified, three sample pavers of each manufactured, type, size and color selected or specified.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Products shall be produced by a single manufacturer unless otherwise specified.
2. Manufacturer shall submit evidence of having not less than fifteen years successful production of this product.
3. The paver manufacturer shall demonstrate, either by proven field performance or a laboratory freeze-thaw test, that the paving units have adequate durability if they are to be subjected to a freeze-thaw environment.

   a. Satisfactory field performance is indicated when units similar in composition and made with the same manufacturing process as those to be supplied to the purchaser, do not exhibit objectionable deterioration after at least 3 years.
   b. The units used as the basis for proven field performance shall have been exposed to the same general type of environment, temperature range and traffic volume as is contemplated for the units supplied to the purchaser.

B. Installer Qualifications:

1. Subcontractor shall submit evidence of skill and not less than five years specialized experience with this product.

C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion. Mock-up installation for each paving pattern indicated on the Drawings shall be a minimum of 6'x6' area.
2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
3. Refinish mock-up area as required to produce acceptable work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and handle precast concrete pavers in such a manner as to prevent damage. Units shall be stored above ground on pallets. Pallets shall be clean and non-staining. All damaged or otherwise unsuitable material shall be immediately removed from the job site.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.7 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
1. Do not work during freezing weather or on wet or frozen sub-base.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Wausau Tile Co., which is located at: P. O. Box 1520 9001 Bus Hwy. 51 ; Wausau, WI 54402-1520; Toll Free Tel: 800-388-8728; Tel: 715-359-3121; Email: wtile@wausautile.com; Web: www.wausaupaving.com.

B. Acceptable Manufacturer: Tremron Group, which is located at 9440 Phillips Hwy, Ste 6, Jacksonville, FL 32256; Toll Free Tel: 866-358-5900; Web: www.tremron.com.

~~C. Substitutions: Not permitted.~~

~~D.~~C. Requests for substitutions will be considered in accordance with provisions of Section ~~01250~~01 25 00 "Product Substitution Procedures."

2.2 PAVERS

A. Concrete Paver: Detectable Warning Concrete Paver as manufactured by Wausau Tile Co.

1. Thickness: Standard, 2 inches - 2-3/4 inches (51 mm - 70 mm).
2. Nominal Size: 12 inches (305 mm) square.
3. Model: ADA-3.
4. Color: A-30.
5. Installation Patterns: As indicated on Drawings.

B. Concrete Paver: Shellstone Concrete Pavers as manufactured by Tremron Group.

1. Thickness: Standard, 2 inches - 2-3/4 inches (51 mm - 70 mm).
2. Nominal Size: 12 inches (305 mm) square.
3. Model: Shellstone Concrete Paver.
4. Color: White.
5. Installation Patterns: As indicated on Drawings.

C. Paver Performance Requirements:

1. Compressive Strength: At the time of delivery to the work site, the average compressive strength shall not be less than 8,000 psi with no individual unit less than 7,000 psi (48,000 kPa) per ASTM C 140.
2. Absorption: The average shall not be greater than 6 percent per ASTM C140.
3. Flexural Strength: Not less than 800 psi (5500 kPa) per ASTM 293.
4. Load carrying capacity: Paver units shall have a tested center load capacity of 1,850 lb (840 kg). WT CL96
5. Freeze/thaw: Durability of the paver shall meet the freeze/thaw tests in accordance with Section 8 of ASTM C1260. Specimens, when tested, shall have no breakage and not greater than 1 percent loss in dry weight of any individual unit when subject to 50 cycles of freeze/ thaw.
6. Sizing: Permissible variations in dimensions shall not differ by more than 1/16 inch (1.6 mm) from width, height, length or thickness. Standard units are manufactured with a 3/16 inch (4.8 mm) bevel on all four sides of finished surface. Unit shall conform to a true plane and not differ by more than 1/16 inch (1.6 mm) in either concave and/or convex warpage.

2.3 INSTALLATION MATERIALS

A. System: Thinset Mortar Method - Pedestrian Installation.

1. Latex Mortar Mix: ANSI A-118.4.
2. Water: Clean and free of deleterious acids, alkalies or organic materials.
3. Grout: ANSI A-118.6, Grout - Latex.
4. Sealant: As specified in Section 07920 - Sealants and Caulking.
5. Back-up: As specified in Section 07920 - Sealants and Caulking.
6. Bond Breaker: As specified in Section 07920 - Sealants and Caulking.

B. System: Portland Cement Setting Bed.

1. Portland Cement Mortar Mix: ASTM C 150 Custom Bldg Products thick Bed Mortar Mix with Admix, or approved equal.

2. Reinforcement: 2 inches by 2 inches (51 mm by 51 mm) - 16/16 welded galvanized wire mesh used in thick mortar bed.
3. Water: Clean and free of deleterious acids, alkalies or organic materials.
4. Grout: Custom Bldg Products Grout with Admix, color as selected or approved equal.
5. Bond Slurry: Custom Bldg Products bond coat or approved equal.
6. Sealant: As specified in Section 07920 - Sealants and Caulking.
7. Back-up: As specified in Section 07920 - Sealants and Caulking.
8. Bond Breaker: As specified in Section 07920 - Sealants and Caulking.

C. System: Bituminous Setting Bed.

1. Asphalt Setting Bed Materials:

   a. Asphalt Cement: ASTM D 3381, viscosity grade AC-10 or AC-20.
   b. Fine Aggregate: Clean, hard sand, free of organic matter, uniformly graded from coarse to fine, all passing the No. 4 sieve meeting the gradation requirements when testing in accordance with ASTM C 136.
   c. Mixing: Provide plant mixed asphalt setting bed by combining dry fine aggregate (approximately 93 percent) and hot asphalt cement (approximately 7 percent) and heat to approximately 300 degrees F (149 degree C). Provide each ton of setting bed material apportioned by weight with the approximate ratio of 145 lb (66 kg) of asphalt to 1,855 lb (841 kg) of sand.

2. Setting Bed Primer: Cut back asphalt, ASTM D 2028, grade as recommended by the paver manufacturer.

3. Asphalt Adhesive: Standard neoprene modified asphalt adhesive containing oxidized asphalt combined with 2 percent neoprene and 10 percent long fibered mineral fibers with a softening point of 155 degrees F.

4. Joint Filler Materials: Sand conforming with ASTM C 144 with 100 percent passing a No. 16 sieve.

5. Pre-formed Asphalt Joint Filler: ASTM D 994, 1/2 inch (13 mm) thick, for expansion joints which are not sealed, one of the following:

   a. Code 1301, W.R. Grace and Co.
   b. Asphalt Expansion Joint, W. R. Meadows, Inc.
   c. Elastite Asphalt Expansion Joint, The Celotex Corporation.

D. System: Open Joint Pedestal Set.

1. Work shall include rigid board insulation, concrete pavers and accessory materials required for complete and proper installation of the pavers system.

2. Tabs and Shim Plates:

   a. The SBR rubber Terra-Tab as manufactured by Wausau Tile Co. Units shall

provide spacing tabs 3/16 inch (4.8 mm) or 1/8 inch (3 mm) allowing for drainage and air circulation. Tabs to have a shore hardness of 70, allowing for resiliency without sound transmission. Tab sizes to correspond with various sizes of pavers.

b. Shim Plates (shims) are 1/8 (3 mm) and 1/4 inch (6 mm) thick and of various sizes to correspond with various size tabs. Shim plates shall be of the same material as the tab.

3. Pedestal Systems:

a. Adjustable Pedestals: Terra-Adjust Adjustable Pedestals as manufactured by Wausau Tile Co. To accommodate various pitches/slopes of project areas. Unit shall have an outside base diameter of 6-1/8 inches (156 mm) giving a contact surface area of 29-1/2 sq. inches (19,000 sq. mm). Unit telescopes from a minimum 2 inches (51 mm) to a maximum 5-1/2 inches (140 mm) and can tilt to a level plane. Extenders and reducers to be used in areas requiring over 5-1/2 inches (140 mm) or under 2 inches (51 mm) in height. Units to be high impact styrene. Tabs are used on top of this unit.

b. Stand Pedestals: Terra-Stand Pedestals as manufactured by Wausau Tile Co. To accommodates various pitches and height changes of the project area. Unit has outside dimension of 7 inches (178 mm). Unit telescopes from a minimum of 2 inches (51 mm) to a maximum of 21 inches (533 mm) and can tilt to a level plane. Units to be high impact copolymer Polypropylene. Tabs are used on top of this unit.

4. Reducer Pedestal System:

a. Extenders/Reducers: Extender gives an additional 4 inches (102 mm) adjustment to a maximum height of 10 inches (254 mm). Reducer is made to accommodate height adjustment between 1/2 inch (13 mm) and 2 inches (51 mm). Units to be high-impact styrene. Tab and shim plates with spacer unit are used on top of this unit.

b. Waffle Reducer: The waffle Reducer is made of high impact copolymer polypropylene. Waffle Reducer is made to accommodate height adjustments 1/2 inch (13 mm) to 2 inches (51 mm). An outside base diameter of 6 inches (152 mm) provides surface contract of 33 square inches (21,290 sq. mm). The unit consists of one base with 3 pieces of 3/8 inch (9.5 mm) waffle rings and 1 piece of 3/4 inch (19 mm) waffle ring.

5. Installation Handles:

a. Paver Blok Handles: Units to handle paver sizes 12 inches to 24 inches (305 mm to 610 mm) nominal, allowing installing contractor to set units into proper location with 3/16 inch (4.8 mm) or 1/8 inch (3 mm) joint between units. Also allows for removal and reinstallation units without causing any damage to units or adjacent units, thus allowing inspection of utilities or drains at any time.

b. Big Blok Handle: Unit to handle paver sizes 24 inches to 36 inches (610 mm to 914 mm) nominal, allowing installing contractor to set units into proper location with 3/16 inch (4.8 mm) or 1/8 inch (3 mm) joint between units. Also allows for

removal and reinstallation without causing any damage to units or adjacent units, thus allowing inspection of utilities or drains at any time.

6. Terra System One Mix:

   a. Pre-mixed blended concrete dry mix to be used with the Terra-adjust System to have a 5,500 psi (38,000 kPa) at 28 days compressive strength.
   b. Material shall comply with requirements of ASTM C387.

7. Other Accessory Materials:

   a. Shall be either provided by the manufacturer of the precast concrete pavers and precast units, or shall be specifically recommended by them.

E. System: Sand-Set Installation.

1. Sand Setting Bed Material: Sand shall common sand generally referred to as concrete sand and shall free of organic materials and any other contaminates that could potentially stain or otherwise damage the unit pavers.
2. Joint Filler Materials: Sand conforming with ASTM C 144 with 100 percent passing a No. 16 sieve.
3. Landscape Filter Fabric: Woven or non-woven non-biodegradable filter between the compacted base and the sand leveling bed.
4. Preformed Asphalt Joint Filler where indicated on drawings: ASTM D 994, 1/2 inch (13 mm) thick, for expansion joints which are not sealed, one of the following:
   a. Code 1301, W.R. Grace and Co.
   b. Asphalt Expansion Joint, W. R. Meadows, Inc.
   c. Elastite Asphalt Expansion Joint, The Celotex Corporation.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Concrete shall not exceed 1/8 inch in 10 feet (3 mm in 3 m) from required plane. Concrete to be steel troweled with fine broom finish. No curing or sealing compound used.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Placement Tolerance:

1. Maximum of 1/16 inch (1.6 mm) height variation between adjacent pavers.
2. Individual pavers shall not vary more than 1/16 inch (1.6 mm) from level across width of the paver.
3. Paved areas shall not vary more than 1/4 inch (6 mm) from level in a distance of 10 feet (3 m) measured at any location and in any direction.
4. Joints between pavers to be 3/16 inch (4.8 mm) or 1/8 inch (3 mm).

C. Thinset Mortar Method - Pedestrian Installation:

1. Installation of Mortar bed as per TCA F102. Materials use shall follow instructions of manufacturer for use in mortar method.
2. Install precast concrete pavers.
3. Grouting of pavers in strict accordance with grout manufacturer's directions and instructions. Latex or acrylic additives of the same manufacturer as the grout.
4. Control and expansion joints shall be installed per TCA EJ 171. Joint materials used shall follow manufacturer's directions and instructions.
5. Rework mixes from time to time to maintain proper consistency, as recommended by manufacturer but do not add ingredients. Discard mortar that has reached its initial set.
6. Field cut precast pavers in accordance with manufacturer's recommendations for methods, equipment and precautions.
7. Cleaning: Remove mortar stains and all other types of soiling from exposed paver surfaces, wash and scrub clean.

D. Portland Cement Setting Bed Installation:

1. Installation of Mortar bed as per TCA F101. All materials used follow instructions of manufacturer for use in mortar method.
2. Install precast concrete pavers.
3. Grouting of pavers in strict accordance with grout manufacturer's directions and instructions. Latex or acrylic additives of the same manufacturer as the grout.
4. All control and expansion joints to be installed as per TCA EJ 171. All joint materials used shall follow manufacturer's directions and instructions.
5. Field cut precast pavers in accordance with manufacturer's recommendations for methods, equipment and precautions.
6. Cleaning: Remove mortar stains and all other types of soiling from exposed paver surfaces, wash and scrub clean.

E. Bituminous Setting Bed Installation:

1. Place solid steel 3/4 inch (19 mm) thick control bars directly on the base or slab. Install shims under bars for minor adjustment of depth and finish paver elevations and slopes. Space bars approximately 11 feet (3.4 m) apart and parallel to each other to serve as guides for strike-off boards.

2. Place asphalt setting bed at not less than 200 degrees F (93 degree C) in panels between control bars on the primed concrete slab or binder course to not less than 3/4 inch (19 mm) compacted thickness. Spread material and strike off by pulling the material with a 12 feet long by 2 inches by 6 inches (3.7 m by 51 mm by 152 mm) wood board several times to produce a smooth firm and even setting bed. Add fresh material in low, porous spots after each pass of the strike-off board. After each panel is complete remove and advance the first control bar to the next panel position in readiness for placing and striking adjacent panels. Fill in depressions left by the control bar and any shims.
3. Roll setting bed with a roller (not over one ton in weight) to a nominal depth of 3/4 inch (19 mm) thick while it is still hot. Add additional material to adjust thickness required and to allow for setting of pavers to finish elevations and slopes.

    a. If setting bed is installed greater than 1-1/2 inches (38 mm) thick, place in two equal lifts. Place the second lift immediately after the first to assure bond between lifts.
    b. If pavers are not installed immediately after setting bed, provide protection of setting bed with minimum 1/2 inch plywood sheet laid on the setting bed with butted joints. Repair all damage to the setting bed prior to installing pavers.

F. Concrete Slab Installation:

1. Install precast concrete pavers, slabs and curbs in locations, patterns and at elevations and with slopes for surface drainage as shown on the Drawings. Install precast concrete pavers, slabs and curbs in accordance with the manufacturer's printed installation instructions and the final reviewed shop drawings.
2. Apply neoprene modified asphalt adhesive on the cured setting bed by squeegeeing or troweling. If troweled on, use a trowel with serrations not exceeding 1/16 inch (1.5 mm) depth. Place adhesive to not more than 1/16 inch (1.6 mm) thickness over the total surface of the setting bed. Do not begin installation of pavers, slabs and curbs until adhesive is dry to the touch.
3. Lay out pavement in 30 feet (9 m) working area modules. Set precast concrete pavers, slabs and curbs by hand on dry adhesive in patterns shown on the Drawings with hand tight joints 1/16 inch to 1/8 inch (1.6 mm to 3 mm) wide joints and uniform top surfaces.
4. Field cut precast concrete pavers in accordance with manufacturer's recommendations for methods, equipment and precautions.
5. Maintain accurate alignment and check for creep and shrinkage. Make adjustments to creep and shrinkage within the 30 feet (9 m) module area.
6. Sweep fine dry sand over pavement surface to fill joints immediately after installing pavers, slabs and curbs on setting bed. Brush in sand until joints are completely filled, remove surplus sand. Do not allow traffic on installed pavers, slabs or curbing until the joints have been filled.
7. Protect newly laid pavers, slabs and curbs with plywood panels on which workers stand. Advance protective panels as work progresses but maintain protection in areas subject to continued movement of materials and equipment to avoid creating depressions or disrupting alignment of installed pavers, slabs and curbs.
8. Install the specified joint filler where precast concrete pavers, slabs and curbs abut curbs, other vertical surfaces and other construction.

9. Backfilling: After the precast concrete paving is completed, backfill the spaces along the edges of the walks, metal edging and pavements to be required elevations with material reviewed by the Testing Laboratory. The Material shall then be compacted until firm and the surface neatly graded, with allowance made for top soil.

G. Sand Setting Bed Installation:

1. Place solid steel 3/4 or 1 inch (19 mm or 25 mm) thick control bars directly on the base. Install shims under bars for minor adjustment of depth and finish paver elevations and slopes. Space bars approximately 11 feet (3.4 m) apart and parallel to each other to serve as guides for strike-off boards.
2. Place sand setting bed between control bars on the binder course to not less than thickness of the designated control bars. Spread material and strike off by pulling the material with a 12 feet long by 2 inches by 6 inches (3.7 m by 51 mm by 152 mm) wood board several times to produce a smooth firm and even setting bed. Add fresh material in low areas after each pass of the strike off board. After each panel is complete remove and advance the first control bar to the next panel position in readiness for placing and striking adjacent panels. Fill in depressions left by the control bar and any shims.

H. Pedestal and Open Joint Installation:

1. Inspection of deck and fixed elevation locations. All height or location problems to be corrected before installation.
2. Compare layout of deck to shop drawings or architectural drawings. All variances of field conditions to drawings to be reviewed and corrected prior to starting installation.
3. Tabs and shim plates are placed, maximum of 2 shims per location, at intersection of grid line if finished surface is to follow slope of substrates. Paver size centerlines shall be adhered to.
4. Level surface installation using adjustable or stand screw-top pedestal to follow manufacturer's installation procedures. No variances to system allowed.
5. Minor height and pitch adjustments are handled with 1/8 inch (3 mm) rubber shim plates.
6. Extender unit is inserted into extended pedestal to provide heights from 5-1/2 inches to 10 inches (140 mm to 254 mm).
7. Reducer unit is used for height adjustments of between 1/2 inch and 2 inches (13 mm and 51 mm) in 3/8 inch (9.5 mm) increments.

3.4 STAIR TREAD/RISERS INSTALLATION

A. Install precast stair tread/risers in accordance with the final reviewed shop drawings.

B. Anchor each unit using stainless steel dowels to the supporting structure. Provide not less than two dowels per each unit. In addition, dowel each unit to the previously installed unit to assure against movement of each and the installation. Grout solid all dowels in precast units and the supporting construction.

3.5 PROTECTION

A. Protect installed products until completion of project.

B. Remove and replace pavers which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment to eliminate evidence of replacement.

C. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 32 1723.10 - PAVEMENT MARKING – PARKING GARAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract 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 surface preparation and application of paint systems for the high build, two coat systems for the items of types, patterns, sizes, and colors described in this article.

B. Provide the following systems as shown on Drawings:

1. Parking Stall Stripes.
2. Traffic Arrows, crosswalks, accessible stall access aisles, walkways, symbols, stop bars, words and other markings.
3. International Symbol of Accessibility.

C. Provide painting of curbs and curb ramps as described in the following paragraphs:

1. Paint vertical surface and the first 6 in. of the abutting horizontal surface at the top of all curbs and islands (including PARCS equipment islands) within parking facility except those which do not exceed 3’0” in width and abut a wall, spandrel panel, bumper wall guardrail or other construction (not including landscaping or equipment) which prevents passage of pedestrians.
2. In parking areas and/or at streets and sidewalks within the project limits or constructed as part of this project, paint curb ramps (including flares), curb returns at curb ramps and any projecting elements at edges of accessible ramps without handrails. Paint curb returns at driveways and paint curb minimum of 3 ft either side of curb ramp or driveway, (or curb ramp flare length, whichever is greater) in accordance with Pavement Marking.
3. Paint color for curbs and curb ramps shall be yellow.

D. Proportion International Symbol of Accessibility in accordance with ICC A117.1-2009 Accessible and Usable Buildings or 2010 ADA Standards for Accessible Design.

E. Related Work:

1. Pavement Marking Contractor shall verify compatibility with sealers, joint sealants, caulking and all other surface treatments as specified in Division 07.

1.3 SUBMITTALS

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

B. Provide product data as follows:

1. Manufacturer’s certification that the material complies with standards referenced within this Section.
2. Intended paint use.
3. Pigment type and content.
4. Vehicle type and content.

C. Submit list of similar projects (minimum of 5) where pavement-marking paint has been in use for a period of not less than 2 yrs.

D. See requirements of Division 01 Section, “Submittal Procedures,” Part 1 heading, “Submittal Procedures,” for limits to resubmittals.

E. See requirements of Division 01 Section, “Submittal Procedures,” Part 2 heading, “Requests for Information,” for RFI constraints.

1.4 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 degrees F.

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 degrees F above the dew point; or to damp or wet surfaces.

1.5 QUALITY ASSURANCE

A. Provide written 1-year warranty to Owner that pavement markings will be free of defects due to workmanship, inadequate surface preparation, and materials including, but not limited to, fading and/or loss of markings due to abrasion, peeling, bubbling and/or delamination. Excessive delamination, peeling, bubbling or abrasion loss shall be defined as more than 15% loss (within the area of work) of marking material within one year of substantial completion and/or occupancy of the parking area. With no additional cost to Owner, repair and/or recoat all pavement marking where defects develop or appear during warranty period and all damage to other Work due to such defects.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pavement marking materials shall meet Federal, State and Local environmental standards.

B. Paint shall be manufactured and formulated from first grade raw materials and shall be free from defects or imperfections that might adversely affect product serviceability.

C. Paints shall comply with the National Organic Compound Emission Standards for Architectural Coatings, Environmental Protection Agency, 40 CFR Part 59.

D. The product shall not contain mercury, lead, hexavalent chromium, or halogenated solvents.

2.2 ACCEPTABLE PAVEMENT MARKING PAINTS:

A. Epoxy paint may be used for all markings, unless noted otherwise on the Drawings. Paint shall be a two-component system consisting of minimum 99 percent solids. The material shall be specifically formulated as a pavement marking material and shall be spray applied at ambient temperatures.

1. The specific paint formulation shall be approved for use on highways by the state and/or local DOT where the project is located.

2.3 COLOR OF PAINT

A. Color of paint unless noted otherwise on Contract Drawings, shall be white and shall match federal color chip 37925 and daylight directional reflectance (without glass beads) shall not be less than 84% (relative to magnesium oxide) when tested in accordance with Federal Test Method Standard 141, Method 6121.

B. Paint color for traffic yellow, where shown on Contract Drawings or specified herein, shall match federal color chip No. 33538 commonly referred to as federal highway yellow. Color shall have daylight directional reflectance (without glass beads) of not less than 50% (relative to magnesium oxide) when tested in accordance with Federal Test Method Standard 141, Method 6121.

C. Paint color for blue accessible parking space pavement markings, if shown on Contract Drawings, shall match federal color chip No. 35180. Color shall have daylight directional reflectance (without glass beads) of not less than 52% (relative to magnesium oxide) when tested in accordance with Federal Test Method Standard 141, Method 6121.

D. Paint color for green special-use parking space pavement markings, if shown on Contract Drawings, shall match federal color chip No. 34108. Color shall have daylight directional reflectance (without glass beads) of not less than 52% (relative to magnesium oxide) when tested in accordance with Federal Test Method Standard 141, Method 6121.

E. Paint color for red special-use parking space pavement markings, if shown on Contract Drawings, shall match federal color chip No. 31136. Color shall have daylight directional reflectance (without glass beads) of not less than 52% (relative to magnesium oxide) when tested in accordance with Federal Test Method Standard 141, Method 6121.

F. Paint color for black special-use pavement markings, if shown on Contract Drawings, shall match federal color chip No. 37038. Black paint shall also meet Federal Specification TT-P-110.

2.4 BEADS

A. Use Glass Beads (Spheres) in all pavement markings except stall striping lines. Conform to Federal Specification TT-B-1325D, Type I. Broadcast beads into markings at rate not less than 6 lbs. per gallon of paint.

2.5 SILICA SAND

A. Silica Sand, where used, shall be foundry grade silica sand composed of at least 99.5 percent silicon dioxide when tested in accordance with ASTM C 146. The gradation of silica sand shall meet the paint manufacturer’s recommendation. Sand shall broadcast into markings at rate not less than 6 lbs per gallon of paint.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

C. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

D. Striping shall not be placed until full cure of concrete slab and sealer. Concrete surfaces generally require 30 to 90 days @ 70°F or higher. Sealers (other than silane) generally require 14 days @ 70°F or higher. Silane sealers require 24 hrs @ 70°F or higher. Bituminous surfaces generally require 30 days @ 45° F or higher.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Do not paint or finish any surface that is wet or damp.

C. Clean substrates of substances that could impair bond of paints, including dirt, dust, oil, grease, and incompatible paints and encapsulates.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Lay out all striping on each tier, using dimensions and details shown on Contract Drawings, before painting that tier. Report any discrepancies, interferences or changes in striping due to field conditions to Engineer/Architect prior to painting. Pavement Marking Contractor shall be required to remove paint, repair surface treatment and repaint stripes not applied in strict accordance with Contract Drawings.

F. Work Areas:

1. Store, mix and prepare paints only in areas designated by Contractor for that purpose.
2. Provide clean cans and buckets required for mixing paints and for receiving rags and other waste materials associated with painting. Clean buckets regularly. At close of each day's Work, remove used rags and other waste materials associated with painting.
3. Take precautions to prevent fire in or around painting materials. Provide and maintain appropriate hand fire extinguisher near paint storage and mixing area.

G. Mixing:

1. Do not intermix materials of different character or different manufacturer.
2. Do not thin material except as recommended by manufacturer.

H. Disposal:

1. Contractor shall properly dispose of unused materials and containers in compliance with Federal Resource Conservation Recovery Act (RCRA) of 1976 as amended, and all other applicable laws and regulations.

3.3 APPLICATION

A. Apply paint in 2-coat system; first coat shall be 50% of total 15 wet mil minimum thickness, not to exceed 8 mils. First coat shall be cured prior to installation of second coat. At Contractor's option, one coat may be applied before substantial completion, with a second coat delayed for 3-6 months until weather conditions are appropriate and the concrete has cured sufficiently for proper adhesion.

1. Two coat system total wet mil thickness of 0.015 in (0.381 mm).
2. Two coat system total wet mil thickness of 0.018 to 0.025 in (0.457 – 0.635 mm) When Type IVA beads are used.
3. Two coat system total wet mil thickness of 0.015 to 0.018 in (0.381 – 0.457 mm) When Type IVB beads are used.

B. Apply painting and finishing materials in accordance with manufacturer's directions. Use applications and techniques best suited for material and surfaces to which applied. Minimum air shall be used to prevent overspray. Temperature during application shall be minimum of 40º F and rising, unless manufacturer requires higher minimum temperature. Maximum relative humidity shall be as required by manufacturer.

C. Application of beads and/or silica sand shall coincide with application of paint, but shall be done as separate operation by a suitable dispenser. Sand may be premixed with paint for application to curbs only. Glass beads and silica sand shall adhere to the cured paint or all marking operations shall cease until corrections are made.

D. All lines shall be straight, true, and sharp without fuzzy edges, overspray or non-uniform application. Corners shall be at right angles, unless shown otherwise, with no overlaps. Line width shall be uniform (-0%, +5% from specified width). No excessive humping (more material in middle than at edges or vice versa).

3.4 APPLICATION OF TEMPORARY PAVEMENT MARKING

A. As required for construction phasing.

~~A.~~B. Temporary pavement markings shall be preformed tape, conforming to ASTM D4592, type 1, removable.

~~B.~~C. Temporary pavement markings shall be applied after paving, but before being opened to traffic and parking. Markings that are improperly applied and come loose shall be replaced at Contractor's expense, as directed by Engineer/Architect.

~~C.~~D. Temporary pavement markings on finished pavement surface shall be installed allowing for lateral tolerance of ±2 in. center to center. Temporary pavement markings that are installed outside specified lateral tolerances shall be removed and replaced, as directed by Engineer/Architect, at Contractor's expense.

~~D.~~E. All marking shall have width of 4 in. unless otherwise specified. Markings shall be either white or yellow per Contract Drawings.

~~E.~~F. Apply and remove preformed tape per manufacturer's instructions.

~~F.~~G. Remove all temporary pavement markings prior to placing permanent pavement markings.

END OF SECTION

SECTION 32 18 13 – SYNTHETIC GRASS SURFACING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Synthetic turf surface.
2. Inorganic loose-fill surface.

1.3 RELATED SECTIONS

A. Division 09 Section “Finish Key” for additional finish and system information.

1.4 PERFORMANCE REQUIREMENTS

A. Nominal Melt Flow Rate: According to ASTM D 1238.

B. Transmissitivity of Surface Systems: According to ASTM D 4716.

1.5 ACTION SUBMITTALS

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

B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: For Leadership Extraction Practices in the following:
   a. Leadership Extraction Practices for Recycled Content
   b. Documentation on Low Emitting Materials.
2. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD’s)

C. Shop Drawings: For each synthetic turf surface system, include materials, plans, cross sections, drainage, installation, penetration details, and edge termination including loose fill edgings.

D. Samples for Verification: For each type of synthetic turf surface system indicated.

1. Minimum 1-quart loose-fill surface sealed in a container.
2. Minimum 6-by-6-inch Sample of synthetic turf surface.
3. 6-inch long by full-size cross section of border edging.
4. Minimum 6-by-6-inch Sample of molded-sheet drainage panel.

E. Product Schedule: For synthetic turf surface systems. Use same designations indicated on Drawings and in Division 09 Section “Finish Key.”

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Extent of surface systems and use zones for equipment.
2. Critical heights for playground surfaces and fall heights for equipment.

B. Qualification Data: For qualified Installer.

C. Material Certificates: For each type of loose-fill synthetic turf surface system, from manufacturer.

D. Product Certificates: For each type of synthetic turf surface system, from manufacturer.

E. Field quality-control reports.

F. Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For synthetic turf surface system to include in maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Synthetic Turf Fabric: Furnish quantity not less than 10 linear feet for every 500 linear feet or fraction thereof, in roll form and in full roll width for each color, pattern, and type of floor covering installed.
2. Termination Edge Units: 3 full-size units.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Source Limitations: Obtain synthetic turf surface system materials from single source from single manufacturer.

1. Provide secondary materials including adhesives, primers, and repair materials of type and from source recommended by manufacturer of synthetic turf surface system materials.

1.10 WARRANTY

A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of synthetic turf surface system that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Reduction in impact attenuation.
b. Deterioration of surface and other materials beyond normal use.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYNTHETIC TURF SURFACE

A. Surface System: Woven synthetic grass turf with drainage sub-base.

1. Recycled Content: Post-consumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent. Refer to Section 01 81 13.14 “SUSTAINABLE DESIGN REQUIREMENTS - LEED V4 BD+C” for additional recycled content requirements.
2. Basis of Design: Subject to compliance with requirements, provide ForeverLawn; K9Grass Lite or approved product by one of the following or approved manufacturer:
   a. Easy Turf
   b. SynLawn.
   c. Approved Substitution.
3. Pile Yarn Type: UV-resistant polyethylene.
4. Yarn Structure: Spined and texturized monofilament.
5. Yarn Denier: 9000 per ASTM D 1577.
6. Pile Height: 1.625 inches per ASTM D 5823.
7. Pile Weight: 45 oz/cy, dual layer woven polypropylene, per ASTM D 5848.
8. Primary Backing Weight: >7 oz/cy, dual system permeable polyurethane, per ASTM D 5848.
9. Secondary Backing Weight: 22 oz/cy, per ASTM D 5848.
10. Total Weight: 94 oz/cy, per ASTM D 5848.
11. Stitch Gauge: 3/8-inch centers, per ASTM D 5793.
12. Antimicrobial Protection: Built-in to blades.
~~12.~~13. Total Infill: 4 lbs/sf.
~~13.~~14. Color(s): As indicated by manufacturer's designations in Division 09 Section “Finish Key.”

B. Leveling and Patching Material: Portland cement-based grout or epoxy- or polyurethane-based formulation suitable for exterior use and approved by playground surface system manufacturer.

2.2 INORGANIC LOOSE-FILL

A. Inorganic Aggregate Materials: Clean, washed, and free of loam, clay, organic matter, debris, and other foreign substances.

1. Acrylic Coated Silica: Consisting of a 12/20 grit.
2. Uncompressed Material Depth: Manufacturer’s standard but not less than as indicated.

2.3 LOOSE-FILL ACCESSORIES

A. Edgings: Anchored-in-place, weather-resistant containment barrier designed to minimize sharp edges, protrusions, and tripping hazards; formed by interconnected, modular units.

1. Polyethylene Units: UV-light-stabilized, 100 percent recycled polyethylene, not less than 1/4-inch wall thickness; made into smooth-surfaced straight and curved units with radiused exposed edges and integral, molded-in color; in manufacturer's standard sizes.
   a. Color: As selected by Architect from manufacturer's full range.
2. Rubber Units: Compression molded from 100 percent recycled SBR, in manufacturer's standard sizes.
   a. Color: As selected by Architect from manufacturer's full range.

2.4 MOLDED-SHEET DRAINAGE PANEL

A. Molded-Sheet Drainage Panel: Manufacturer’s standard prefabricated, drainage panel tiles.

1. Drainage Panel Tile: Three-dimensional, non-biodegradable, molded-polypropylene-sheet material designed to effectively drain water under maximum fill pressures.
   a. Weight: 1.5 lb per tile.
   b. Size: 24-inches by 24-inches nominal.
   c. Nominal Melt Flow Rate: 20g/10 minutes according to ASTM D 1238.
   d. Notched Izod Impact Strength: No break according to ASTM D 256A.
   e. Specific Gravity: 0.92 g/cc.
   f. Thickness: 0.5-inches.
   g. Compressive Stress: 180 psi according to ASTM D 6364.
   h. Volume Voids: 84%.
   i. Surface Voids: 71%.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer and CMAR present, for compliance with requirements for maximum moisture content, subgrade and substrate conditions, drainage, and other conditions affecting performance of the Work.

B. Hard-Surface Substrates: Verify that substrates are satisfactory for synthetic turf surface system installation and that substrate surfaces are dry, cured, and uniformly sloped to drain within recommended tolerances according to synthetic turf surface system manufacturer's written requirements for cross-section profile.

1. Concrete Substrates: Verify that substrates are dry, free from surface defects, and free of laitance, glaze, efflorescence, curing compounds, form-release agents, hardeners, dust, dirt, loose particles, grease, oil, and other contaminants incompatible with playground surface system or that may interfere with adhesive bond. Determine adhesion, dryness, and acidity characteristics by performing procedures recommended in writing by playground surface system manufacturer.

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

3.2 PREPARATION

A. General: Prepare substrates to receive surfacing products according to playground surface system manufacturer's written instructions. Verify that substrates are sound and without high spots, ridges, holes, and depressions.

B. Concrete Substrates: Provide sound surface free of laitance, efflorescence, curing compounds, and other contaminants incompatible with playground surface system.

1. Repair unsatisfactory surfaces and fill holes and depressions.
2. Treat control joints and other nonmoving substrate cracks to prevent telegraphing through playground surface system.

3.3 INSTALLATION, GENERAL

A. General: Comply with synthetic turf surface system manufacturer's written installation instructions. Install playground surface system over area and in thickness indicated.

3.4 DRAINAGE PANEL INSTALLATION

A. General: Install drainage panel tiles according to synthetic turf surface system manufacturer's written instructions.

3.5 INSTALLATION OF SYNTHETIC TURF SURFACE SYSTEMS

A. Turf Surface: Install components of synthetic turf surface system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of total thickness indicated.

3.6 INSTALLATION OF LOOSE-FILL

A. Loose-Fill Edgings: Place as indicated, and permanently secure in place and attach to each other according to manufacturer's written instructions.

B. Loose Fill: Place synthetic turf surface system materials including manufacturer's standard amount of excess material for compacting mechanically to required depths after Installation of drainage panels.

3.7 PROTECTION

A. Synthetic Turf Systems: Prevent traffic over system for not less than 48 hours after installation.

END OF SECTION 09 62 53

SECTION 32 31 19 - DECORATIVE METAL FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK INCLUDED

The contractor shall provide all labor, materials and appurtenances necessary for installation of the welded ornamental steel fence system defined herein.

1.3 SYSTEM DESCRIPTION

The manufacturer shall supply a total fence system of Montage II® *Welded and Rackable* (ATF – All Terrain Flexibility) Ornamental Steel Invincible™ design. The system shall include all components (i.e., panels, posts, gates and hardware) required.

1.4 QUALITY ASSURANCE

The contractor shall provide laborers and supervisors who are thoroughly familiar with the type of construction involved and materials and techniques specified.

1.5 REFERENCES

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or

B. Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

C. ASTM B117 - Practice for Operating Salt-Spray (Fog) Apparatus.

D. ASTM D523 - Test Method for Specular Gloss.

E. ASTM D714 - Test Method for Evaluating Degree of Blistering in Paint.

F. ASTM D822 - Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.

G. ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.

H. ASTM D2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.

I. ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).

J. ASTM D3359 - Test Method for Measuring Adhesion by Tape Test.

K. ASTM F2408 – Ornamental Fences Employing Galvanized Steel Tubular Pickets.

1.6 SUBMITTALS

A. Product Data for each type of product indicated.

B. Samples for Initial Selection for units with factory-applied color finishes.

C. Samples for Verification for each type of exposed finish required, prepared on samples not less than 6-inch-long linear components and 4-inch-square sheet components.

D. Product Schedule for site furnishings. Use same designations indicated on Drawings.

E. Material Certificates for site furnishings, signed by manufacturers.

F. Maintenance Data for site furnishings to include in maintenance manuals.

1.7 PRODUCT HANDLING AND STORAGE

Upon receipt at the job site, all materials shall be checked to ensure that no damage occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism and theft.

1.8 PRODUCT WARRANTY

A. All structural fence components (i.e. rails, pickets, and posts) shall be warranted within specified limitations, by the manufacturer for a period of 20 years from date of original purchase. Warranty shall cover any defects in material finish, including cracking, peeling, chipping, blistering or corroding.

B. Reimbursement for labor necessary to restore or replace components that have been found to be defective under the terms of manufactures warranty shall be guaranteed for five (5) years from date of original purchase.

PART 2 – PRODUCTS

2.1 DECORATIVE METAL FENCES AND GATES

A. Products: Products specified for this project are listed on the Site Furnishings Schedule within the construction drawings

B. Product substitution will be considered only if the alternative product is considered equal or better in terms of materials, sizes, dimensions, finishes, features, accessories, maintenance requirements and performance.

2.1 MANUFACTURER

A. The fence system shall conform to Montage II® *Welded and Rackable* (ATF – All Terrain Flexibility) Ornamental Steel, Invincible™ design, extended picket, bottom rail treatment, and 3-Rail style manufactured by Ameristar Fence Products, Inc., in Tulsa, Oklahoma. Contact Matt Bean at 888.333.3422 for additional information.

2.2 MATERIALS

A. Steel material for fence panels and posts shall conform to the requirements of ASTM A653/A653M, with a minimum yield strength of 45,000 psi (310 MPa) and a minimum zinc (hot-dip galvanized) coating weight of 0.90 oz/ft2 (276 g/m2), Coating Designation G-90.

B. Material for pickets shall be 1" square x 14 Ga. tubing. The rails shall be steel channel, 1.75" x 1. 75" x .105". Picket holes in the rail shall be spaced 4.715" o.c. Fence posts and gate posts shall meet the minimum size requirements of Table 1.

2.3 FABRICATION

A. Pickets, rails and posts shall be pre-cut to specified lengths. Rails shall be pre-punched to accept pickets.

B. Pickets shall be inserted into the pre-punched holes in the rails and shall be aligned to standard spacing using a specially calibrated alignment fixture. The aligned pickets and rails shall be joined at each picket-to-rail intersection by Ameristar's proprietary fusion welding process, thus completing the rigid panel assembly (Note: The process produces a virtually seamless, spatter-free good-neighbor appearance, equally attractive from either side of the panel).

C. The manufactured panels and posts shall be subjected to an inline electro deposition coating (E-Coat) process consisting of a multi-stage pretreatment/wash (with zinc phosphate), followed by a duplex application of an epoxy primer and an acrylic topcoat. The minimum cumulative coating thickness of epoxy and acrylic shall be 2 mils (0.058 mm). The color shall be Black. The coated panels and posts shall be capable of meeting the performance requirements for each quality characteristic shown in Table 2 (Note: The requirements in Table 2 meet or exceed the coating performance criteria of ASTM F2408).

D. Finish: For the Service Animal Relief Area fencing, all pickets, channels, posts, fittings and accessories shall be polyester coated individually after drilling and layout, to ensure maximum corrosion protection. All components are given a 4 stage "Power Wash" pre-treatment process that cleans and prepares the galvanized surface to assure complete adhesion of the finish coat. All metals are then given a polyester resin based power coating applied by the electrostatic spray process, to a thickness of 2.5 (.0635 mm) mils. The finish is then baked in a 450^0F (232^0C) (metal temperature) oven for 20 minutes. Color: Black.

E. The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for Industrial weight fences under ASTM F2408.

F. Swing gates shall be fabricated using 1.75" x 14ga Forerunner double channel rail, 2" sq. x 11ga. gate ends, and 1" sq. x 14ga. pickets. Gates that exceed 6' in width will have a 1.75" sq. x 14ga. intermediate upright. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined by welding. Gusset plates will be welded at each upright to rail intersection. Cable kits will be provided for additional trussing for all gates leaves over 6'.

PART 3 - EXECUTION

3.1 PREPARATION

All new installation shall be laid out by the contractor in accordance with the construction plans.

3.2 FENCE INSTALLATION

Fence post shall be spaced according to Table 3, plus or minus ½". For installations that must be raked to follow sloping grades, the post spacing dimension must be measured along the grade. Fence panels shall be attached to posts with brackets supplied by the manufacturer. Posts shall be set in concrete footers having a minimum depth of 36" (Note: In some cases, local restrictions of freezing weather conditions may require a greater depth). The "Earthwork" and "Concrete" sections of this specification shall govern material requirements for the concrete footer. Posts setting by other methods such as plated posts or grouted core-drilled footers are permissible only if shown by engineering analysis to be sufficient in strength for the intended application.

3.3 FENCE INSTALLATION MAINTENANCE

A. When cutting/drilling rails or posts adhere to the following steps to seal the exposed steel surfaces

1. Remove all metal shavings from cut area.

2. Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry.

3. Apply 2 coats of custom finish paint matching fence color. Failure to seal exposed surfaces per steps 1-3 above will negate warranty.

4. Ameristar spray cans or paint pens shall be used to prime and finish exposed surfaces; it is recommended that paint pens be used to prevent overspray. Use of non-Ameristar parts or components will negate the manufactures' warranty.

3.4 GATE INSTALLATION

Gate posts shall be spaced according to the manufacturers' gate drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected. Type and quantity of gate hinges shall be based on the application; weight, height, and number of gate cycles. The manufacturers' gate drawings shall identify the necessary gate hardware required for the application. Gate hardware shall be provided by the manufacturer of the gate and shall be installed per manufacturer's recommendations.

3.5 CLEANING

A. The contractor shall clean the jobsite of excess materials; post-hole excavations shall be scattered uniformly away from posts.

B. Refer to Section 01 7423 Final Cleaning for all final cleaning.

Table 1 – Minimum Sizes for Montage II Posts	
Fence Posts	Panel Height

2-1/2" x 12 Ga.	Up to & Including 6' Height
3" x 12 Ga.	Over 6' Up to & Including 8' Height

Gate Leaf	Gate Height		
	Up to & Including 4'	Over 4' Up to & Including 6'	Over 6' Up to & Including 8'
Up to 4'	2-1/2" x 12 Ga.	3" x 12 Ga.	3" x 12 Ga.
4'1" to 6'	3" x 12Ga.	4" x 11 Ga.	4" x 11 Ga.
6'1" to 8'	3" x 12 Ga.	4" x 11 Ga.	6" x 3/16"
8'1" to 10'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
10'1" to 12'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
12'1" to 14'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
14'1" to 16'	6" x 3/16"	6" x 3/16"	6" x 3/16"

Table 2 – Coating Performance Requirements

Quality Characteristics	ASTM Test Method	Performance Requirements
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 1,500 hours (Scribed per D1654; failure mode is accumulation of 1/8" coating loss from scribe or medium #8 blisters).
Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625" ball).
Weathering Resistance	D822 D2244, D523 (60˚ Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).

Table 3 – Montage II – Post Spacing By Bracket Type

Span	For INVINCIBLE® 8' Nominal (91-1/2" Rail)				For CLASSIC, GENESIS, & MAJESTIC 8' Nominal (92-5/8" Rail)					
Post Size	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"
Bracket Type	Industrial Flat Mount (BB301)*		Industrial Line 2-1/2" (BB319) 3" (BB320)		Industrial Universal 2.5" (BB302) 3" (BB303)		Industrial Flat Mount (BB301)		Industrial Swivel (BB304)*	
Post Settings ± ½" O.C.	94-1/2"	95"	94-1/2"	95"	96"	96-1/2"	96"	96-1/2"	*96"	*96-1/2"

*Note: When using BB304 swivel brackets on either or both ends of a panel installation, care must be taken to ensure the spacing between post and adjoining pickets meets applicable codes. This will require trimming one or both ends of the panel. When using the BB301 flat mount bracket for Invincible style, rail may need to be drilled to accommodate rail to bracket attachment.

END OF SECTION

SECTION 32 84 00 - LANDSCAPE IRRIGATION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide all labor, materials, equipment and services to complete the Irrigation Systems Installation.

B. The installation of the landscape irrigation system includes, but is not limited to:

1. All piping, including mains, laterals, conduits, fittings, sleeves under walks, water connections, tees, risers, clamps, and swing joints.

2. All control, gate, check pressure reducing, pressure sustaining quick coupling, and other valves, pressure gauges, isolation valves, pressure sensors, flow sensors, soil moisture sensors, including valve boxes, markers, connections, operators, actuators and other accessories.

3. Communication equipment to automatically communicate with the existing airport central control system including, low voltage connections, electrical, internet connections, control cable and decoders, radio and antenna links or cable conduit, and coordination of 120V electrical.

4. Provide a complete antenna survey will have to be conducted to assure proper placement of antennae to assure communication to the central controller and all satellite controllers.

5. All rotor, rotating nozzle, spray, and drip emitter devices, including nozzles and other appurtenances and accessories for a complete operating system.

6. Connections of piping to the supply sources.

7. All excavation site work, relocation or replacement of existing irrigation lines, backfill, compaction and restoration of all disturbed areas per these specifications and the drawings.

C. Provide a complete and operable system for the irrigation of all areas.

D. Adjust head location, type and size, and other system components to comply with the requirements of landscaping.

E. Store and protect all equipment and materials including pipe and fittings, sprinkler heads, valves, controllers, wire, and all other component parts necessary.

F. On-Site Conditions:

1. Protection of Property: Preserve and protect of all site conditions to remain, and existing irrigation equipment, from damage due to the works of this project. All damage that does occur shall be completely repaired to its original condition.

2. Trenching: All trenching or other work under the leaf canopy of all trees shall be done by hand or by other approved methods so that branches are not damaged. Trenching around existing plant material shall be done by hand so as to minimize root disturbance. Buildings, foundations, walks, walls, and other property shall be protected from damage. Open ditches left exposed shall be flagged and barricaded by approved means. Restore disturbed areas to original condition.

3. Protection and Repair of Underground Utilities: Request utility companies to stake the exact location of underground lines, including but not limited to, electric, gas, telephone, water and cable. Take whatever precautions necessary to protect underground lines from damage. In the event damage does occur, all damage shall be completely repaired to its original condition.

1.2 QUALITY ASSURANCE

A. All irrigation work shall be performed by qualified personnel that has a minimum of 5 years of experience in irrigation systems. Must also be familiar with Ethernet radio link systems

B. Contractor has the responsibility to make further repairs, corrections and adjustments to eliminate any deficiencies which may later be discovered.

C. On-Site Observation: At any time during the installation of the irrigation system, the Owner may visit the site to observe the Work. Should the material, workmanship or method of installation not meet the standards specified herein, the Contractor shall be responsible for all replacement expenses.

D. Workmanship: All work shall be installed by qualified, skilled personnel, proficient in the trades required with recognized standards of workmanship

PART 2 - PRODUCTS

2.1 PIPING

A. All PVC pipe shall be purple color and marked “Reclaimed Water Do No Drink” per state and local codes for reclaimed water supplied irrigation systems.

B. The irrigation system pipe and fittings shall be capable of withstanding a sustained pressure of at least 150 psi.

C. Polyvinyl Chloride (PVC Pipe) Class 200 Fluid-Tite gasket joint shall be used on all main lines, before individual zone valves.

D. All nipples, pipe connections, bushings, etc. required shall be PVC pipe Schedule 80.

E. All pipe extensions for varied height shrub risers and PVC pipe sleeves under paved areas shall be PVC pipe Schedule 40.

G. All PE pipe for tree irrigation zones shall be PE3408, SIDR 15, pressure rated for 100PSI, with insert x thread fittings and Oetiker clamps.

2.2 PIPE FITTINGS

A. All pipe fittings on all sizes of mainline shall be as follows:

1. On gasket joint pipe, all directional pipe fittings shall be push-on joint, ductile iron fittings, class 250, with transition gaskets used with PVC pipe according to PVC pipe class.

2. All gasket joint directional fittings on gasket joint pipe shall use series 2000 MEGALUG mechanical joint restraint kit for the proper PVC pipe class being installed. See joint restrain guide in Appendix A.

3. All threaded service tees for control valves, quick coupler valves and air release valves shall be ductile iron gasket joint. MJ restraints are not needed on service tees, except adjacent to gate valves and end of line caps. See joint restrain guide in section 3.1 D.

B. All lateral line pipe fittings shall be PVC Sch. 40 solvent weld fittings

C. All service tees to solenoid control valves are to be ductile iron gasket joint threaded service tees.

2.3 PVC PIPE CEMENT AND PRIMER

A. Provide solvent cement and primer for PVC solvent weld pipe and fittings as recommended by the manufacturer.

B. Solvent weld cement capable of being used under water shall be Uni-Weld 2400 (turf-tite or approved colored substitute) with compatible primer Uni-Weld 8700 HI ETCH Purple Primer or approved colored substitute.

2.4 THREADED CONNECTIONS

A. Threaded PVC Connections shall be made up, using Teflon tape or Teflon pipe dope.

B. Connection between mainline pipe fittings and solenoid control valves shall be made using Schedule 80 PVC threaded nipples and elbows. All control valves will be installed off of a ductile iron service tee with a 2” outlet utilizing schedule 80 nipples, couplers and 90’ elbows

2.5 THRUST BLOCKS

A. Mainline piping shall have thrust blocks sized and placed in accordance with the pipe manufacturer's recommendations and as detailed on the drawings. Thrust blocks shall be a standard poured concrete mix.

2.6 SPRINKLER HEADS

A. All sprinkler heads shall be manufactured by Rain Bird. Provide triple swing joint connections to the lateral line the same size as the threaded base of the sprinkler body.

1. Spray heads shall be Rain Bird 1800 Series with check valve and pressure compensating features and nozzle configurations to ensure full coverage. The nozzle extension shall be a 6".

2. Heavy-duty, closed case rotor shall be Rain Bird 5500 Series rotor and the Rain Bird 8005 series with a check valve feature and nozzle size and configuration to

ensure full coverage. The nozzle extension shall be at least 5" pop-up installed one inch above grade before sod or mulch layer

2.7 CONTROL SYSTEM

A. Fully integrate the satellite irrigation controls as shown on the drawings with the existing central control system for a fully automatic and properly functioning irrigation system.

B. Provide soil moisture sensor devices as indicated on the drawing and wire into the controller two wire control cable.

2.8 SATELLITE CONTROLLERS

A. The irrigation satellite controller shall be provided as indicated on the drawings.

C. Electrical Characteristics:

(1) Peak Signal/Line Voltage - Line to Line = 50V;Line to Ground = 50V

(2) Maximum allowable DC current per line = 1.5A

(3) Maximum in-line DC resistance - .3 Ohms

(4) DC clamping voltage @ 1mA, typical - line to line = 70V; line to ground = 70 V

(5) Maximum DC leakage current @ 50V - line to line and line to ground = 20uA

(6) Surge clamping voltage, maximum (50 Ohms load)

(a) 8x20us, 1000A current pulse - line to line = 65V; line to ground = 55V

(b) 8x20us, 5000A current pulse - line to line = 75V; line to ground = 70V

(c) 10x1000us, 500A current pulse - line to line = 90V; line to ground = 115V

C. All controllers shall be equipped with a permanent hand held remote controller connector.

2.9 ELECTRICAL CONTROL VALVES

A. The remote control valve shall be as indicated on the drawings. Provide a normally closed 24 volt AC 60 cycle solenoid actuated globe pattern diaphragm type. Valve pressure rating shall be tested to 200 psi. The valve body and bonnet shall be constructed of heavy-duty glass filled nylon. The diaphragm shall be of nylon reinforced nitrile rubber. The scrubber shall consist of a stainless steel cylinder screen and plastic scraper.

B. The valve shall have a pressure regulating module capable for regulating outlet pressure between 15 and 100 PSI (±5 PSI). Module shall have an adjusting screw for setting pressure and a schrader valve connection for monitoring pressure.

C. The valve shall be actuated by a low power two wire decoder signal. The solenoid plunger shall have a "Grit Filter" to insure a positive valve operation.

D. The valve shall have a flow control stem and wheel handle for regulating or shutting off the flow of water and an internal bleed plug for manual operation without electrically energizing the solenoid coil.

E. The valve construction shall be such as to provide for all internal parts to be removable from the top of the valve without disturbing the valve installation.

2.10 VALVE BOXES

A. For gate valves, use Tyler No. 6890, Matco, or approved substitute cast iron valve box with cast iron lid. If Re-Use water is being used, then cast iron lid shall be labeled, Re-Use.

A. Drip valve assembles, quick coupler and hose bib, use Highline box or approved substitute; for Re-Use water, substitute with lavender lid. For all electric valves, use Highline box or approved substitute; for Re-Use water, substitute with lavender lid or approved substitute.

B. For control wiring splices, use Highline box or approved substitute.

D. Valve boxes shall be installed flush with finished grade as detailed on the drawings except in beds, then 3 inches above finished grade.

2.11 CONTROL WIRE & SPLICE MATERIAL

A. All two-wire control cable and ground wires shall be provided per the irrigation drawings. Provide AWG #12 Gauge conductor wire with PVC insulation and bear UL approval for direct underground burial feeder cable.

B. All wire connections and splices shall be made with 3M DBR/Y-6 or approved substitute. All wire connections and wire splices shall occur in valve boxes.

C. All control cable and sensor cable shall be installed in 1.25” grey electrical conduit with sweep ells and pull boxes every 200 feet. Control valve boxes may be used as pull boxes.

2.12 FLOW SENSORS AND PULSE DECODER

A. The flow sensor and pulse decoder shall be provided as indicated on the irrigation drawings.

2.13 QUICK COUPLER VALVES AND AIR RELIEF VALVES

A. Quick coupler valves shall be 3/4" Rain Bird No. 33-DNP Series.

B. Valves to be mounted on tripe O-ring swing joint manufactured by Lasco or Spears, with 315 PSI pressure rating, as shown on detail sheet.

C. Supply one (1) Rain Bird No. 33-DK Series quick coupler key and one (1) swivel hose SH-1 for every seven quick coupling valves installed.

D. Provide air relief valves on the high points of the irrigation mainline as indicated on the plans.

2.14 LOW VOLUME DRIP IRRIGATION

A. Provide low volume drip irrigation tubing, fitting, stakes, drain valves, air release valves, indicator heads, PVC header pipes, filters, pressure regulators, control valves and jumbo valve boxes as indicated on the drawings.

B. In line drip tubing emitters shall be spaced 12 inches on center, with tubing rows 18 inches on center. Stake all tubing down with galvanized sod staples every 4 feet on center.

C. Install tubing perpendicular to slopes, and with in-line type four (4) pound check valves installed on the PVC header pipes at six foot intervals.

D. Install filters in valve boxes for easy access and removal for cleaning.

2.15 BACKFLOW PREVENTION UNITS

A. Backflow prevention units, if required, on the reclaimed water points of connection, shall be a double check type per the irrigation drawings.

PART 3 – EXICUTION

3.1 PIPE INSTALLATION

A. Stake out the location of each run of pipe, sprinkler heads, and valves prior to trenching.

B. Excavation shall be unclassified and shall include all materials whatsoever encountered in the excavation of trenches for pipe installation. The trench shall be of sufficient width and depth for installation of the pipe as indicated herein. Disturbances shall be held to minimum at all existing conditions wherever possible. Bore under existing pavement and sidewalks. No pavement shall be cut without the Owner's permission.

C. Trenches shall be made wide enough to allow a minimum of 4 inches between parallel pipe lines. Parallel lines shall not be installed directly over one another. Lateral lines shall be placed at sufficient depths to provide the minimum cover from finish grade as follows:

1. 18" minimum cover over mainlines.
2. 18" minimum cover over control wires from controller to valves.
3. 12" minimum cover over lateral lines to heads.
4. Maintain all warning signs, shoring, barricades, flares and red lanterns as required by the Safety Orders of the Division of Industrial Safety and any local ordinances and codes.

D. The pipe and fittings shall be inspected before installation in the trench. All rocks over 2" diameter and unsuitable bearing material shall be removed from trench in strict accordance with the manufacturer's recommendations.

1. Solvent welded joints shall be made only on clean, dry, square cut, smooth pipe sections. The fittings shall be "dry" tested for proper size before solvent is applied. The assembly shall proceed in strict accordance with recommended procedures furnished by the manufacturer.

2. Solvent welded pipe sections shall be "snaked" from side to side in the trench to prevent joint rupture due to thermal contraction.

3. Pipe openings shall be plugged during construction to prevent entrance of foreign materials.

4. Gasket joint fittings and pipe joints shall be restrained using the following guide:

HARCO JOINT RESTRAINT SELECTION GUIDE

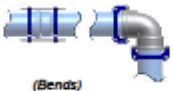
NUMBER OF ADJACENT JOINTS TO RESTRAIN

Tables below list number of adjacent pipe joints to be restrained for basic fitting configurations. These were calculated using the joint restrain calculator available at www.harcofittings.com for a set of assumptions that will envelope many applications. If your situation is not covered by the assumptions or a more refined restraint scheme is desired, use the restraint calculator at www.harcofittings.com.

BENDS, REDUCERS, CAPS AND VALVES:

Size	Bends				Reductions			Dead Ends
	11½	22½	45	90	1	2	3	
2	-	-	-	-	-	-	-	-
2½	-	-	-	-	-	-	-	1
3	-	-	-	-	-	-	1	1
4	-	-	-	-	-	1	1	2
6	-	-	-	1	1	2	2	3
8	-	-	-	1	1	3	3	4
10	-	-	-	1	1	2	3	4
12	-	-	-	1	2	2	3	4
14	-	-	-	1	1	2	3	4
16	-	-	-	2	1	2	3	5

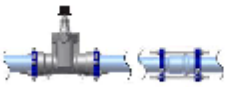
BENDS & CAPS/DEAD ENDS: Restrain all bells and the adjacent joints listed in table, (both directions for bends).


(Bends)


(Caps/Dead Ends)

REDUCERS: Restrain large bell and adjacent joints listed in table.

VALVES: Treat as Dead End. Use Valve Restrain and restrain adjacent upstream joints listed in table. If closed valve can have pressure from either sides, restrain adjacent joints both sides per table.



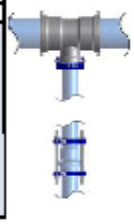
RESTRAINT CALCULATION ASSUMPTIONS:
Maximum Pressure: 125 psi
Restrained Lengths: Each restraint connects 20 ft. length of pipe.
Soil Type: Type GM, gravel-sand-silt mixture
Minimum Burial Depths: 2" - 2½", 18" cover; 3" - 8", 24" cover; 10" - 12", 30" cover; 14" - 16", 36" cover.
Trench Type: 3, pipe bedded in 4 inches minimum loose soil. Backfill lightly consolidated to top of the pipe.
Safety Factor: 1.5

TEES - BRANCH BELL ONLY RESTRAINED:

Use joint restraint ONLY on branch. Number below is number of 20' joints to be restrained with pipe to pipe restraints.

Run Size	Tees (Branch Size)									
	2	2½	3	4	6	8	10	12	14	16
2										
2½										
3										
4	-									
6	-	1	1							
8	-	1	1							
10	-	-	1	1						
12	-	-	1	1						
14	-	-	1	1	1					
16	-	-	1	1	1					

Use Chart below for more economical method



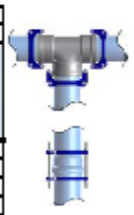
TEES - ALL BELLS RESTRAINED:

Use joint restraint on ALL three branches of tee. Number below is number of 20' joints to be restrained with pipe to pipe restraints in branch only direction.

Run Size	Tees (Branch Size)									
	2	2½	3	4	6	8	10	12	14	16
2	-	-	-	1						
2½	-	-	-	-						
3	-	-	-	-						
4		-	-	-	-					
6				-	-					
8				-	-					
10					-					
12					-					
14										
16										

Use Joint Restraint Calculator

Use Chart above



TEES W/RUN REDUCTIONS:
Restrain all bells and adjacent branch joints noted. Treat run reduction as a reducer. Restrain as noted adjacent joints to large bell per reducer table.

E. Backfill shall be carefully placed to avoid pipe dislocation. Backfill material shall be free of rocks, stumps, roots and other unsuitable material. In planting areas, the top six inches (6") shall be suitable planting soil. Backfill shall be placed in six inch (6") lifts and shall be

thoroughly compacted by mechanical tamping except in planting areas where planting soil is used. The surface of backfilled trenches shall be even with the surrounding ground surface. Plant locations shall take precedence over sprinkler and pipe locations. Coordinate the routing of lines and final head locations with the placement of trees and shrubs.

3.2 SPRINKLER HEAD INSTALLATION

A. Place all sprinkler heads, adjust all nozzles, spray patterns, and make whatever other adjustments that may be required to give the landscaped areas full, complete and uniform coverage and distribution, and to meet all manufacturer's requirements. All such adjustments and additions shall be at the Contractor's expense.

B. Sprinkler heads located along curbs and edges of paving shall be installed 6" from back of curb or paving. Along roadways without curbs, sprinkler heads shall be located 72" from edge of non-curbed pavement,

C. Sprinkler heads shall be installed as designated on the drawings. Heads shall be installed on triple swing joints. Angled nipple relative to lateral line shall be no more than 45° or less than 10°. The top of all sprinkler heads shall be set 1" above finish grade before much or sod installation.

D. All sprinkler head risers above finished grade shall be staked and stabilized per details. Use black UV approved zip strip ties only.

E. Spacing of heads shall not exceed the minimum indicated on the drawings (unless directed by the irrigation designer). In no case shall the spacing exceed the maximum recommended by the manufacturer.

H. Before sprinkler heads are set, flush foreign matter from the lines.

I. Install using a 1/2" Schedule 80 nipple and triple swing joint as detailed. Rain Bird 1800 Series pop-up spray heads with the SAM-PRS features shall have connections made at the bottom inlet.

3.3 SATELLITE CONTROLLER INSTALLATION

A. Install all automatic satellite controllers for the complete and proper automatic operation of the irrigation system. Electric control valves shall be connected to controller in a clockwise sequence to correspond with station settings noted on the plans beginning with Stations 1, 2, 3, etc. The location of all satellite controllers shall be approved by the Owner prior to installation.

B. All satellite controllers shall be equipped with surge arrestors as specified. Surge protection of 5 OHMS or less is required. If grounding rods will not give the 5 OHMS or less, 150 feet of bare No. 6 wire will be installed 8 inches to 12 inches depth into an irrigated area. This wire will be connected to the ground rod by a brass, single piece clamp. Wire used to connect equipment to grounding rod shall be one (1) size larger than largest wire used on the irrigation system (at same location), and connected with a brass, single piece clamp.

C. To be installed according to the latest ~~Rain Bird~~Baseline specifications.

3.4 CONTROL WIRE INSTALLATION

A. Install control cables minimum 18 inches below finish grade and positioned below and to the side of the mainline. Provide a minimum of ten extra feet of control cable at each control valve. Snake cable in trench to allow for contraction of cable. Color-coded cables shall be used for each separate satellite controller. The control cable must be deeper than the mainline pipe.

B. All underground wire splices shall be made at electric valves in valve boxes, per the controller manufacturer's specifications.

C. All wire passing under existing or future paving or construction shall be encased in Schedule 40 PVC conduit extending at least 12 inches beyond edges of paving and stabilized for construction.

D. Any wire installed outside the mainline trench shall be placed in 1 inch Class 160 PVC electrical conduit with sweep ells. Install conduit 18 inches minimum depth and per local electrical codes.

E. Provide a Paige Decoder Cable Fuse Device (DCFD) at each split in the two wire path. Paige 270DCFD-x. At each satellite controller provide a Paige DCFD with a Base Line surge suppression module and ASIC level ground grid per the irrigation drawings where the two wire cable exits the controller.

F. Provide a Base Line surge suppression module and ASIC level ground

3.5 VALVE AND VALVE BOX INSTALLATION

A. Quick Coupling Valves: Installed on mainline pipe every 200 ft. The connection between the main line and quick coupler valve shall be with a threaded Schedule 80 PVC pipe and a triple O-ring swing joint.

D. Electric Control Valves: Installed in specified valve boxes at the depth specified on the drawings. The valve box shall have 6" layer of 3/4" pea gravel installed below the bottom of the valve. Assure percolation beneath the valve box by approved methods. The valve shall be connected to the main line with Schedule 80 PVC extensions as necessary to ensure valve is properly positioned in the valve box as shown in the details.

E. Electric control valves shall be installed where shown and grouped together where practical (NO MORE THAN 2 ITEMS PER SERVICE TEE). Place valve box no closer than 3 feet from edges of sidewalks, walk edges, buildings and walls, and no closer than 7 feet from the back of curb along roadways or centerline of swales. Adjust the valve to avoid positioning in centerlines of swales. Adjust the valve to provide flow rate or rated operating pressure required for each sprinkler circuit.

F. A threaded PVC ball valve is to be installed prior to the upstream connection of the irrigation control valve to allow repair or replacement without turning off the main line

G. Pressure reducing valves with low flow by- pass AMES 910 series non electric hydraulically operated properly sized to pipe diameter. And same sized gate valve installed up stream of pressure reducing valve

3.6 PAINT

A. Exterior alkyd enamel, flat black, shall be used on above ground PVC risers and other designated irrigation equipment.

B. All metal fittings or components are to be painted with a tar based paint or a 2-part epoxy paint. Provide two coats of paint.

3.7 FIELD QUALITY CONTROL

A. Any malfunctions, deficiencies, breaks, damages, disrepair, or other disorder due to materials, workmanship, or installation shall be immediately corrected.

3.8 PIPE AND WIRE SLEEVES

A. New Sleeves: Install irrigation system pipe and wire sleeves conforming to the following:

1. All pipe sleeves shall have an inside diameter of at least 2" greater than the outside diameter of the pipe or wire bundle it is to hold.
2. All pipe sleeves shall extend a minimum of 36" beyond the edges of pavement, and be protected from soil intrusion.
3. All pipe sleeves to be installed beneath future/existing road surfaces shall be PVC Pipe Schedule 40 or jack and bore steel pipe as per FDOT specifications and as shown on plans.
4. All irrigation system wires shall be sleeved separately from main or lateral lines.
5. All pipe sleeves shall be installed at the minimum depth specified for mainlines, lateral lines, and electric wire.
6. Coordinate all pipe sleeve locations and depths prior to initiating installation of the irrigation system with Owner’s Rep.
7. Adjust the system layout as necessary to properly align with all pipe sleeves.

B. Existing Sleeves: Verify location of existing sleeves and notify Owners Rep of any discrepancies.

3.9 SATELLITE CONTROLLERS

A. Coordinate equipment, labor, conduit, radio communication wire, connections, etc. for the indirect wireless connection with existing central irrigation control system, satellite controllers, and sensor/pulse decoders as specified.

B. All work shall be fully coordinated with the site works and the Owner, and conform in strict accordance with all applicable codes.

C. The Contractor shall provide complete, continuous and non-interrupted irrigation control communication with the central irrigation controller.

D. Test grounding at each controller for impedance to ground by using a Megger meter and provide grounding materials to achieve grounding test to 5 OHM of resistance or less.

E. All controllers shall have ground rods and plates, and control wire with surge arrestor modules and ground rods as specified by the controller manufacturer and detailed on the irrigation drawings.

F. Radio antennae instillation, repair, replacement or relocation is the responsibility of the contractor to assure optimum function of the system

3.10 FLOW SENSOR AND PULSE DECODER

A. Where new point of connection is being installed, provide flow sensor, sensor decoder, master valve, and master valve decoder per the irrigation drawings.

B. Calibrate the flow sensor at the POC and certify accuracy of the device in writing to the Owner.

3.11 GATE VALVES

A. All gate valve boxes shall be installed flush with finished grade. Assure percolation beneath the gate valve box by approved methods. Gate valves shall be installed inside valve boxes as previously specified and as detailed on the drawings.

3.12 CONNECTION TO RECLAIMED WATER

A. Point of connection for the reclaimed water system shall be as indicated on the irrigation drawings, and per City of Orlando standards.

3.13 TESTING

A. Prior to backfilling of mainline fittings, fill the mainline piping with water and purge the air from the piping by operating all the sprinkler control valves one or more times or such other means as may be necessary. A small, high pressure pump or other means of maintaining a continuous water supply shall be connected to the mainline and set so as to maintain 150 PSI in the mainline system for two (2) hours without interruption. When this has been accomplished and while the pressure in the system is still 150 PSI.

1. Pressure readings shall be noted and make up water usage shall be recorded. Should the rate of make up water usage indicate significant leakage, the source of such leakage shall be found and corrected and the system then retested.

2. Lateral line testing shall be conducted during the operating testing of the system by checking visually the ground surface until no leaks in this portion of the system are evident.

B. Maintain the irrigation system until final completion and turn over, including but not limited to, adjustments, repairs, integration with the master control system, etc.

C. Test all grounding systems. Grounding systems shall measure 5 OHMS or less when measured with Megger meter equipment.

END OF SECTION

SECTION 32 91 13 SOIL PREPARATION

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. Labor, materials, necessary equipment and services to complete the Soil Preparation and Soil Mixes work as indicated.
   2. Topsoil (existing soil on site and imported as required)
   3. Soil Conditioners
   4. Prepared Planting Soil Mixes.

1.3 QUALITY ASSURANCE

A. Testing Agency: Independent testing laboratory

B. Requirements or Regulatory Agencies: Conform to requirements of all local government agencies, City, County and State agencies.

C. Test Reports: Test reports shall consist of pH range, major and minor element analysis, soluble salt concentrations, sand fraction analysis and testing laboratory recommendations as to suitability of soil for planting and drainage. Reports shall be identified by project name, date, and soil mix type. Include the following:
   1. Results of topsoil (on-site existing soil) analysis from 8 places on site as determined by the Architect.
   2. Results of planting soil mixes analysis: One test required per each type of soil mix with and without specified fertilizer (note: pH ranges for plant type).
   3. Results of Sand Analysis: One sand fraction analysis required.
   4. Results of imported topsoil analysis.

D. Certificates: Provide the following.
   1. Manufacturer's certification and/or testing laboratory certification that content of soil

conditioners meets specification requirements.

2. Manufacturer's certificate of fertilizer's chemical composition including but not limited to percentage and derivation of nitrogen, phosphorus, potassium, and micro-nutrients.

3. Submit all certification to the Architect a minimum of one week prior to installation of any materials.

C. Soil Samples:

1. Submit one-pound sample of each soil mix specified. Submit soil samples with required test reports a minimum of one week prior to installation beginning. Each sample must be clearly labeled as to contents and location.

2. Submit one-pound sample of each soil conditioner required to mix each prepared planting soil mix.

3. Schedule soil samples with Architect to verify location, time, conditions, etc. of samples.

1.5 JOB CONDITIONS

A. Bring all areas to finished grade. Any changes, modifications, or disturbances to the fine grading shall be corrected.

B. Protection: Protect and avoid any damage whatsoever to existing walks, pavement, curbs, utilities, plant material, and any other existing work that is to remain.

C. Stabilize all slopes and planting soil by approved methods.

1.6 Soil Amendment Cost Allowance:

Contractor shall include One Hundred Thousand Dollar ($100,000) Cost Allowance to provide the soil amendments as required by the specifications stated herein within their bid for this scope of work. The allowance shall include all testing, materials, labor, equipment, installation, and applications per these specifications

PART 2 -PRODUCTS

2.1 TOPSOIL (ON-SITE EXISTING SOIL)

A. Topsoil Source for Planting: Site excavated or grading where required.

B. Topsoil Description: Topsoil shall be suitable for ornamental plant growth and free from hard clods, stiff clay, hardpan, gravel, subsoil, brush, large roots, refuse, or other deleterious material, and of reasonably uniform quality.

C. Mechanical Analysis: Topsoil and soil mixture(s) shall meet these specifications and the

following mechanical analysis:

1. Percentage Passing by Sieve Size Dry Weight:

   1 inch 99-100
   1/4 inch 97-99
   No. 200 less than 7%

2. Materials larger than one inch shall be disposed of off the site or as directed by the architect.

3. Existing leaf litter and plant material shall be excluded from topsoil and soil mix.

D. Maximum Soluble Salts: 300 ppm.

E. Assure existing soils are free of any visible weeds.

F. In the event topsoil on site does not meet the above requirements, topsoil meeting the requirements may be imported from off-site sources after approval by Architect at no additional cost to the Owner.

2.2 SOIL CONDITIONERS

A. Dolomitic Limestone: Approved product, designated for agriculture use.

B. Aluminum Sulfate: Manufacturer's standard commercial grade.

C. Canadian Peat: Suitable for plant growth, capable of sustaining vigorous plant growth, and specifically pulverized for agricultural use. Canadian peat shall be free of deleterious materials that would be harmful to plant growth, shall be free of nematodes, shall be of uniform quality, and shall have a pH value between 5.5 and 6.5 (as determined in accordance with ASTM E70). Canadian peat shall be sterilized to make free of all viable nut grass and other undesirable weeds.

D. Pesticides: As recommended by applicable Agricultural Public Agencies.

E. Pre-emergent Herbicide: Chipco Ronstar-G as manufactured by Bayer.

F. Post Emergence Herbicide: ~~Apply Green Product~~Apply Green Product similar to "Roundup" manufactured by Monsanto Corp.~~. Roundup~~ Roundup is not acceptable.

G. Soil Fumigant: Basamid G granular soil fumigant, as manufactured by Certis USA, Ltd.

H. Soil Drain/PAM: Soil conditioner by Complete Green Co., El Segundo, Ca. (800) 473-3699.

G. Fertilizer:

1. Commercial grade fertilizer to comply with State of Florida Fertilizer laws. Chemical designation shall be as specified with at least 50% of the nitrogen derived from a non-water soluble organic source and all potash to be derived from triple super sulfate forms for all plantings (i.e. submit suppliers analysis affirming the above).

2. The following minor elements shall be included: Zn Cu; Mg Fe; Mn B.

3. Fertilizer shall be Lesco Palm and Tropical Ornamental Fertilizer with a NPP ratio of 8-2-12 or approved equal. Adjust specified analysis of fertilizer with required minor elements as required depending upon test results of existing soils, planting soil(s) and testing laboratories recommendations at no additional cost to Owner.

4. Federal Specifications O-F-241 Type 1, Grade A or B.

H. Water: Free of substances harmful to growth of plants. Water shall also be free of staining agents as well as elements causing odors.

J. Sand: Clean, white, coarse-grained (0.5 mm or greater) builders sand, free of substances harmful to growth of plants. Beach sand shall not be used.

K. Gravel: Clean (washed), and free from substances harmful to growth of plants. Gravel shall consist of ½" minimum diameter to 1-1/2" maximum diameter stones with 50% of the stones greater than 1" diameter.

L. Sulfur: Hard granular, slow release and free from substances harmful to growth of plants. Sulfur shall be broadcast at a rate of 1,000 lbs. per acre tilled into the soil.

M. Iron Sulfate: Coppers or green vitriol, blue green in color. Apply at a rate of 4 lbs. per 100 SF of bed area tilled into the soil.

N. Supply complete information on all analysis/test methodologies and results; laboratory certifications, manufacturers specifications, and agency approvals to

O. Prior to placement of soil conditioners make all modifications and improvements to soil and soil mixes necessary to meet requirements and to ensure proper growing medium for all plant material without cost to Owner, prior to planting.

2.3 PLANTING SOIL MIXES

A. General: Planting soil mixture(s) shall be suitable for plant growth and free from hard clods, stiff clay, hardpan, gravel, brush, large roots, nematodes, weeds, refuse, or other deleterious material, and of reasonably uniform quality.

B. Trees, Shrubs and Groundcovers: Refer to the Plant Schedule.

C. Palms: Refer to the Plant Schedule.

D. Provide certification that all planting soil mixtures are 99% free of all viable nut grass, and other undesirable weed seeds.

E. All planting soil mixes shall be thoroughly blended to form a uniform planting medium suitable for exceptional plant growth.

F. Test pH of existing soil and planting soil mixtures by method acceptable to current industry standards. If pH is not between 5.5 and 6.5 add approved soil conditioner/additive to bring pH within that range.

G. The planting soil mixture for all plant material specified which grow best in slightly acidic soil shall have a pH range between 4.5 and 5.5. In the event that these pH ranges cannot be achieved, the desired pH shall be achieved by applying fertilizer or hard granular sulfur in quantities necessary to adjust the pH to the specified range.

H. Supply complete information on all analysis/test methodologies and results; laboratory certifications, manufacturers specifications, and agency approvals to Architect prior to placement of soil mixtures. In addition, provide Architect with thoroughly mixed sample of all soil mixes for approval prior to placement (note pH ranges). Make all modifications and improvement to soil mixes deemed necessary by Architect to meet requirements and to ensure proper growing medium for all plant material without cost to Owner, prior to planting.

PART 3 -EXECUTION

3.1 INSPECTION

A. Examine areas to receive soil preparation to assure work of other trades has been completed.

B. Verify that plants to remain undisturbed have been clearly identified and protected from injury during construction. If not, identify and protect plants to remain according to procedures set forth in Section 329300 Plants.

C. Remove all construction materials and debris from all areas to be landscaped, without additional expense to Owner, prior to subsoil preparation.

D. Verify that all areas have been properly graded and that all planting areas have adequate surface drainage prior to planting.

E. Do not proceed with soil preparation or soil top dressings until all unsatisfactory conditions are corrected.

F. Verify representative soil percolation test for planting pits in each project area to ensure proper soil drainage prior to planting. Schedule percolation test with Architect to verify compliance.

3.2 SITE PREPARATION

A. General: Within the entire area to be landscaped, as shown on the drawings, complete the following site topsoil preparation items to eradicate all existing weed and/or natural groundcover. Initiate site topsoil preparation as indicated and coordinate all work with the existing underground sprinkler system and electrical lines.

B. Post Emergence Herbicide: Apply "Roundup" manufactured by Monsanto Corp. according to manufacturers recommended rate and specification within the limits of all areas specified on the plans to be landscaped.

1. Protect existing plants from overspray.

2. Ensure total eradication of all existing weed and/or natural groundcover of all areas to be landscaped within the project area prior to proceeding with site clearing and/or tillage.

3. Existing sod areas or seeded areas may be stripped as required. Dispose of excess materials.

C. Soil Preparation Area Clean Up

1. After all areas have been treated with post emergence herbicide and its effective period, as determined by the manufacture has expired, thoroughly clear all remaining treated existing weeds and/or groundcover, stumps, stones larger than 2" in diameter, roots, cable, wire, and all other debris or materials that may hinder proper grading, tillage, planting, or subsequent maintenance operations by approved means.

2. All cleared material shall be totally removed from the project site and properly disposed of off property.

3. After all debris except the remaining treated weeds and/or groundcover noted above has been cleared from the project site, add the required amendments and till all landscape areas to a depth of at least 6" by plowing, disking, harrowing, or other approved methods until the condition of the site topsoil is acceptable for landscape planting in the Landscape Architect's opinion.

4. When conditions are such, be reason of drought, excessive moisture, or other factors, that satisfactory results are not likely to be obtained, the work may be stopped by the contractor agency and shall be resumed only when directed.

5. Undulations or irregularities in the surface that would interfere with further construction operations or maintenance shall be leveled before the next specified operation.

D. Grading:

1. Upon completion of tilling the site topsoil as described above and deemed acceptable by

the Landscape Architect, fine grade all areas to the previously-established existing grades.

2. All areas shall be maintained in a true and even condition.

3. All areas shall be positively drained to existing drainage structure and properly compacted to prevent the formation of depressions where water will stand.

4. All undulations and irregularities in the surface resulting from tillage, grading or application of soil amendments shall be leveled prior to initiating landscape planting.

5. Re-pin all areas that have eroded to bring the site area to receive the planting to a correct, smooth and uniform condition.

E. Pre-Emergence Herbicide: Apply pre-emergence herbicide to all areas to be landscaped according to the manufacturers recommended rate and specification. Re-apply appropriate herbicide to eradicate all remaining weeds and maintain a weed-free condition in all areas throughout all landscape planting operations.

F. All herbicide and soil fumigant applications shall be completed by experienced personnel only, in strict accordance with applicable codes and regulations, and contained within the limits of areas to be landscaped. Replace all existing landscape material present on the site with equal sized material that may be damaged while applying herbicide, including overspray or improper application of herbicide, at his own expense.

G. Acceptance: Upon completion of all site topsoil preparation, request acceptance from the Architect prior to initiating landscape planting.

3.3 PERFORMANCE

A. Subsoil: Remove all debris, gravel, rocks and other deleterious material over 2" in diameter, within 12" of surface in planting areas from the project site. Fine grade subsoil including disking top 12" of existing soil to assure finish grades are achieved.

1. Upon approval of existing topsoil for use in planting soil mixes, excavate beds to receive planting soil conditioners and till in conditioners with the approved existing top soil to depths as specified and/or detailed.

B. Soil Mixtures:

1. Prior to installing planting soil, test tree pits and planting areas for percolation. If areas do not drain, assure percolation by approved means (i.e. addition of gravel or excavate deeper to break through clay soil etc.).

2. Remove rocks and other objects over one inch (1") in diameter.

3. Smooth soil mixtures to three inches (3") below top of surrounding paving, wherever

planting beds abut paved surfaces. All beds not next to paving will be raised 24” above existing grade to ensure positive drainage.

4. Do not compact planting soil mixture, but do wet-soak planting areas to assure proper settlement. Replace topsoil/planting soil mixture to specified grade after watering, where necessary.

5. Remove limerock or soil cement and or any other materials deleterious to plant growth and survivability around paved or construction areas. Do not damage sub-base material for paved surfaces. Assure percolation and then backfill with approved planting soil mix.

6. Excavate annual beds and replace soil with approved planting soil mix.

3.4 CLEAN-UP

A. Immediately clean up spills, soil and conditioners on paved and finished surface areas.

B. Refer to Section 01 7423 Final Cleaning for all final cleaning.

C. Remove debris and excess materials from project site immediately.

END OF SECTION

SECTION 32 92 00 - TURF AND GRASSES

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. Sodding
2. Soil Preparation
3. Plants

1.3 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

D. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.

E. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

F. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.4 SUBMITTALS

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

1. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to this Project.

B. Qualification Data: For qualified landscape Installer.

C. Product Certificates: For soil amendments and fertilizers, from manufacturer.

D. Material Test Reports: For standardized ASTM D 5268 topsoil, existing native surface topsoil, existing in-place surface soil, and imported or manufactured topsoil.

E. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required initial maintenance periods.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful turf establishment.

1. Experience: Five years' experience in turf installation in addition to requirements in Division 01 Section "Quality Requirements."

2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

3. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

4. Pesticide Applicator: State licensed, commercial.

B. Soil-Testing Laboratory Qualifications: An independent laboratory or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

C. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of the soil.

1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.

2. The soil-testing laboratory shall oversee soil sampling, with depth, location, and number of samples to be taken per instructions from Architect. A minimum of three representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.

3. Report suitability of tested soil for turf growth.

a. Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. or volume per cu. yd. for nitrogen, phosphorus, and potash nutrients and soil

amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.

b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.

D. Pre-installation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.

2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.

3. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

1.7 PROJECT CONDITIONS

A. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

1.8 MAINTENANCE SERVICE

A. Initial Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable turf is established but for not less than the following periods:

1. Sodded Turf: 30 days from date of Substantial Completion.

B. Continuing Maintenance Proposal: From Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 - PRODUCTS

2.1 TURF GRASS SODDING

A. Turf: Certified, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.

B. Turf Species: As indicated on the Plant Schedule.

2.2 FERTILIZERS

1. Commercial grade fertilizer to comply with State of Florida Fertilizer laws. Chemical designation shall be as specified with at least 50% of the nitrogen derived from a non-water soluble organic source and all potash to be derived from triple super sulfate forms for all plantings (i.e. submit suppliers analysis affirming the above).

2. The following minor elements shall be included: Zn Cu; Mg Fe; Mn B.

3. Fertilizer shall be Lesco Palm and Tropical Ornamental Fertilizer with a NPP ratio of 8-2-12 or approved equal. Adjust specified analysis of fertilizer with required minor elements as required depending upon test results of existing soils, planting soil(s) and testing laboratories recommendations at no additional cost to Owner.

4. Federal Specifications O-F-241 Type 1, Grade A or B.

2.3 PESTICIDES

A. General: Pesticide, registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

2.4 EROSION-CONTROL MATERIALS

A. Erosion-Control Fiber Mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb/sq. yd., with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches long.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting performance.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.

2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.

3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.

4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.

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

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect grade stakes set by others until directed to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION

A. General: Limit turf subgrade preparation to areas to be planted.

B. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 4 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply fertilizer directly to subgrade before loosening.

C. Unchanged Subgrades: If turf is to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:

1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.

2. Loosen surface soil to a depth of at least 6 inches. Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top 4 inches of soil. Till soil to a homogeneous mixture of fine texture.

a. Apply fertilizer directly to surface soil before loosening.

3. Remove stones larger than 1 inch in any dimension and sticks, roots, trash, and other extraneous matter.

4. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.

D. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.

E. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

F. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 TURF SODDING

A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is muddy.

B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

1. Lay sod across angle of slopes exceeding 1:3.

2. Anchor sod on slopes exceeding 1:6 with wood pegs spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.

C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

3.5 TURF MAINTENANCE

A. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and re-mulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.

2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.

3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.

2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.

C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

D. Turf Postfertilization: Apply fertilizer after initial mowing and when grass is dry.

1. Use fertilizer that will provide actual nitrogen of at least 1 lb/1000 sq. ft. to turf area.

3.6 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Architect:

1. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.

B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

3.7 PESTICIDE APPLICATION

A. All applications shall be completed by a GreenPro or GreenShield certified applicator and follow the recommendations of those procedures. Apply pesticides and other chemical products and biological control agents in accordance with requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.8 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

C. Remove non-degradable erosion-control measures after grass establishment period.

D. Refer to Section 01 7423 Final Cleaning for all final cleaning.

END OF SECTION

SECTION 329300 – EXTERIOR PLANTS

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. Plants
2. Soil Preparation
3. Mulch
4. Landscape Maintenance

1.3 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Finish Grade: Elevation of finished surface of planting soil.

C. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

D. Pests: Living organisms that occur where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

E. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

F. Sub-grade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

G. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

H. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

I. Injury; defined, without limitation, as any bruising, scarring, tearing, or breaking of roots, trunk, bark, branches or foliage which may lend to or result in permanent damage to plant health or significantly alter the desired aesthetics of the plant for which it was intended.

J. Dead Tree; is a tree that has died or that has been damaged or stressed to an advanced state of decline and has been determined to be so by the Owner's Certified Arborist.

K. Drip Line; defined as the outer most limits of the tree canopy.

L. Certified Arborist; an individual with a current certification from the International Society of Arboriculture (ISA) or member of the American Society of Consulting Arborists trained and experienced in all aspects of proper tree care.

1.4 REFERENCES

A. International Society of Arboriculture (ISA) - 'Guide for Plant Appraisal 8th Edition 1992,' prepared by the Council of Tree and Landscape Appraisers (CTLA).

B. Standardized Plant names; as established by Hortus III.

C. 'Cabling, Bracing, and Guying Standards for Shade Trees,' as published by the National Arborist Association (NAA), 174 Rt. 101, Bedford, NH 03102.

D. ANSI: A300 - 'American National Standards for Tree, Shrub, and Other Woody Plant Maintenance - Standard Practices'. 1995.

E. ANSI Z60.1 - American standards for Nursery Stock, 2004, as approved by the American Association of Nurseryman.

F Florida Grades and Standards….

1.5 SUBMITTALS

A. Submit for Owner's approval within 30 days after award of contract and prior to any start of work

B. Submit manufacturer's data sheets for all proposed products to be used in work. Indicate specific items and product numbers. Required Submittals include, but are not limited to, the following:

1. Schedule with milestone dates and manpower projections.
2. List of key personnel and qualifications
3. Existing soil mix(es) and samples
4. Prepared soil laboratory analysis with testing laboratory recommendations
5. Fertilizer recommendations by testing laboratory
6. Fertilizer(s) guarantee analysis
7. Soil chemical and sand fraction analysis
8. Percolation rate analysis
9. Foliar spray fertilizer(s)
10. Plant supplier certifications from growers
11. Erosion control fabric
12. Pre-and post-emergent herbicides
13. Maintenance manual

C. Product Data for each type of product indicated, including soils.

D. Mulch: 1-quart volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.

E. Plants: Contractor shall furnish all plant material indicated on Drawings. Any and all substitutions due to unavailability shall be requested in writing prior to confirmation of ordering. Submit the following for the Landscape Architect's approval within 30 days after award of contract and prior to any start of work:

1. Documentation listing all required plant material by size, source, and quantity. Sort list by construction zone sequence if applicable.

2. Provide a 4 x 6 in. photos representative of each tree, shrub, vine, and groundcover species. Clearly label each photo with nursery source, plant name, container size and general width, height and caliper of plant.

F. Weed control program: Include all product information and schedule of operations.

List of proposed equipment to be used for tree planting and plan for plant storage on-site.

G. Certificate of Inspection: Provide certificate of inspection of plant materials by State Authorities.

H. Grower's Certification: Provide certification stating requirements for root pruning and holding B&B stock at the nursery.

I. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:

1. Manufacturer's certified analysis of standard products.

2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

J. Material Test Reports for Planting Soil Mix: Provide signed, original copy of test reports indicating characteristics of soil, with test date no more than 2 weeks old.

1. Laboratory Test Report of Organic Amendment: Provide signed, original copy of test reports indicating specified characteristics of organic amendment, with test date no more than 2 weeks old.

2. Soil Tests for Parasitic Nematodes:

a. Test soils for parasitic nematodes.

b. Soil will be acceptable if the parasitic nematode population is less than 200 per 50 cubic centimeters of soil.

c. Do not artificially dry soil prior to testing.

3. Soil Tests for Herbicide Contamination: Perform a radish/rye grass growth trial on soils suspected of herbicide contamination.

K. Maintenance Instructions: Furnish three copies of written maintenance instructions to the Owner's Representative for installed plants throughout their full growing season.

L. Project Schedule: Provide five (5) copies of a comprehensive project schedule indicating proposed work and installation schedule.

1. Schedule shall include breakdown for site preparation and fine grading, watering, trees, shrubs, groundcovers, sod/seed, and final clean-up.

2. Proposed schedule and sequence of work plan for all planting operations, with start dates and completion dates for planting trees, shrubs and groundcovers.

3. Include project "milestone dates" for designated project areas within the total project area as required including substantial completion dates.

4. All major changes in work schedules require a revised schedule indicating changes and milestone dates affected.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful establishment of plants.

1. Experience: Five years' experience in landscape installation in addition to requirements in Division 01 Section "Quality Requirements."

2. Pesticide Applicator: State licensed, commercial.

B. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

1. Pesticide Applicator: State licensed, commercial.

C. Soil-Testing Laboratory Qualifications: An independent or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

D. Soil Analysis: For each un-amended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory.

1. The soil-testing laboratory shall oversee soil sampling.

2. Report suitability of tested soil for plant growth.

a. State recommendations for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.

b. Report presence of problem salts, minerals, or heavy metals; if present, provide additional recommendations for corrective action.

E. Plant Materials

1. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1

2. All plant material shall meet or exceed Florida Department of Agriculture and Consumer Services' Grades and Standards, "Florida Grade No.1" grade and standard, and "Florida Fancy" grade and standard as specified.

3. Furnish plant materials certified by State Department of Agriculture to be free from harmful insects or apparent disease. Verify that all plant material is free of harmful insects and disease. Inspection by State Department of Agriculture shall at the growing site.

4. Plant material shall be shade or sun grown, and/or acclimatized depending on planting location.

5. All plant material shall be received in a healthy condition, free from pests and disease. Plants delivered to Contractor that are found to be damaged, root bound, diseased or distressed shall be brought to Owners' attention prior to accepting delivery.

6. Pre-selection and tagging of plant material by Owner Representative is to meet design intent only and does not constitute any guarantee by Owner of the selected plants. Health and vigor of plant material shall remain the sole responsibility of Contractor.

7. Owner reserves the right to have plant samples analyzed at any time to verify health and conformity to Specifications. Furnish samples upon request. Testing to be done by Owner's designated laboratory.

8. Cost of testing plant samples will be responsibility of Contractor. Lab fees for testing found to be negative will be reimbursed by Change Order to the Contract.

9. Rejected material shall be promptly removed and replaced at no cost to Owner.

10. Inspection and tagging at growing site does not preclude right of rejection at project site.

G. Pre-installation Conference: Conduct conference at Project site.

H. Settlement Mock-Up: Mock-up one 4 by 8 foot area of typical planting bed with backfill mix at the specified depths and apply irrigation to induce settlement to assist in determining the amount of settlement which will be caused by irrigation and rain. Use settlement observed in mock-ups and adjust backfill depth accordingly.

I. On-site Soils

1. After rough grading has been completed and prior to planting operations, on-site soils are to be tested for suitability and amending requirements. Contractor shall make all

adjustments to comply with final soils analysis recommendations as directed by soils report.

2. Contractor shall engage the services of a qualified agricultural soils testing laboratory to perform soil testing services of all areas to be planted. Laboratory services shall include the following:

   a. A minimum of six samples or one sample per 5000 sq. ft. (whatever quantity is greater) of base soil after completion of rough grading in landscape areas as directed by Owner.

   b. Chemical analysis and written report of each individual sample to cover the following:

   c. Soil structure and percentage of organic matter.

   d. pH, Salinity and Lime content

   e. Mineral nutrients, including concentrations of nitrogen, phosphorus, potassium calcium, magnesium, iron, manganese, zinc, copper, sulfur, and molybdenum.

   f. Potential hazards to healthy plant growth such as high salinity, sodium chloride, boron, impaired soil structure, or drainage.

   g. Recommendations for organic materials, fertilizers, and other materials found necessary to amend base soil for optimum plant growth.

   h. Recommendations for backfill mix, or mix as appropriate to be utilized in installation of all plants for the project.

   i. Testing laboratory shall follow standards set forth in the USDA Agricultural Suitability Test in accord with Handbook-60 and the University of California Soil Fertility Test for Soils Analysis.

   j. Testing laboratory may be employed by Owner to provide additional periodic sampling and testing of amended landscape planting areas to ensure compliance with recommendations.

J. Import Soil

1. In the event that supplemental or replacement planter soils are required, all proposed import soils for planting areas shall meet specified requirements and be pre-approved by Owner based on soil test results.

2. Cost for soils tests for this purpose shall be paid by Contractor. Provide chemical analysis report and written recommendation for each individual sample to Owner.

3. In the event that the initial proposed import soil if found unsuitable, additional sources shall be found and tested at Contractor's expense.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Inventory: Verify that all plant species, quantity, and quality of plants match that on Plant List and Drawings

B. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with

state and federal laws if applicable.

C. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.

2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.

3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.

D. Preparation for Delivery:

1. Prune head and/or roots of all trees per ANSI A300 Standards as required to assure safe loading, shipment and handling without damaging the natural form and health of the plant.

2. Balled and Burlapped (B&B) Plants:

a. Dig and prepare for shipment in manner that will not damage roots, branches, shape, and future development after replanting. Oak trees, Magnolias and other soft and hardwood trees shall be root pruned a minimum of 60 days prior to digging and hardened off at the supplier's nursery under mist for 60 days.

b. Ball with firm, natural balls of soil, per "American Standards for Nursery Stock", as published by the American Association of Nurserymen.

c. Wrap ball firmly with burlap or strong cloth and tie: ANSI Z60.l.

E. Deliver balled and burlapped plant stock direct from nursery.

F. Deliver bare-root stock plants, direct from supplier, freshly dug. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.

G. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

H. Handle planting stock by root ball.

I. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

J. Deliver soil conditioners (pesticides, herbicides, and fertilizers) to site in original unopened

containers bearing manufacturer's guaranteed chemical analysis, name, trademark, and conformance to state law. Store in designated areas only.

K. Deliver planting soil mixes and mulch in bulk with manufacturer's guaranteed mix, name, and conformance to State law. Store in designated areas only.

L. Notify Owner of delivery schedule in advance so plant material may be inspected upon arrival at job site.

M. Storage:

1. Protect roots of all plant material from drying or other possible injury. Keep plant root ball and crown moist at all times.

2. Store plants in shade and protect from weather. Heel in trees in a vertical position. Irrigate all stored plants as required.

3. Maintain and protect plant material not to be planted within four hours.

N. Handling:

1. Do not drop plants.

2. Do not pick up container or balled plants by stems or trunks.

3. Do not use chains or cables on any trees. Handle using nylon straps, 2" width minimum.

4. Protect all plant material during delivery to prevent damage or desiccation to root ball or desiccation of crown and leaves.

O. Mist periodically each day all tree root balls and crowns/tops during delivery, handling, and storing on site to ensure against drying.

P. Remove unacceptable plant material immediately from job site.

1.8 PROJECT CONDITIONS

A. Planting Season: Perform actual planting only when weather and soil conditions are suitable in accordance with locally accepted practice.

B. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

C. Interruption of Existing Services or Utilities:

1. Locate all underground utilities and other non-readily visible structures prior to digging. Utility drawings will be available at the job site or from Owner's Representative. Landscape Contractor shall repair all damage to underground utilities, and/or construction caused by utility damage, at no cost to the Owner.

1. Do not interrupt services or utilities to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary services or utilities according to requirements indicated

2. Notify Owner no fewer than two days in advance of proposed interruption of each service or utility.

3. Do not proceed with interruption of services or utilities without Owner's written permission.

D. Environmental Requirements: Do not work soil when moisture content is so great that excessive compaction does not occur, nor when it is so dry that dust will form in the air or that soil clods will not break readily.

E. Tilling: Apply water, if necessary, to bring soil to an optimum moisture content for tilling.

1. Do not work soil when muddy or frozen.

F. Existing Trees: Verify that all existing trees to remain are properly identified and barricaded to prevent damage during all construction. Landscape Contractor shall be responsible for maintaining adequate identification and barricading of all existing plant material to remain throughout the installation and required maintenance period

G. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

H. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

I. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

J. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.9 WARRANTY

A. Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within a one (1) year warranty period beginning on the date of Substantial Completion, except annuals. Failures include, but are not limited to, the following:

1. Death and unsatisfactory growth, except for defects resulting from abuse.

2. Structural failures including plantings falling or blowing over

B. Replacement plants under this guarantee shall be replaced within (2) two weeks of rejection and guaranteed for one (1) year from date of replacement installation

C. Repair damage to other plants, lawn or construction work during plant replacement at no cost to the Owner (this includes, but is not limited to, damage to curbs, walks, roads, fences, site furnishings, etc.).

1.10 SCHEDULING

A. Coordinate work and installation as required with other contractors within the project area that may be in progress as required.

B. Notify Architect and Owner of anticipated installation date at last (2) two weeks in advance.

1.11 MAINTENANCE SERVICE

A. Provide complete landscape maintenance by skilled and knowledgeable employees with a minimum of 5 years' experience in landscape maintenance. Maintain as required in Part 3 of this specification section. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.

B. Maintenance Period for all landscape plant materials included in project's scope of work, including but not limited to trees, palm, shrubs, groundcovers, grasses, turf, and annuals for a period of one (1) year from the date of Final Acceptance as defined in the General Conditions.

C. Provide the Owner with a Continuing Landscape Maintenance Proposal for the years following the initial warranty period. Proposal shall delineate services, obligations, terms and conditions in detail with monthly and annual cost. Include option for annual one (1) year renewal for landscape maintenance.

PART 2 -PRODUCTS

2.1 PLANT MATERIAL

A. Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule.

All Plant Material will meet the standards set forth in Florida Grades and Standards.

1. All plants shall be grown under climatic conditions similar to those in location of project.

2. All shrubs and ground covers shall be container grown.

3. All trees shall be bagged and burlapped or container grown.

4. Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

C. Container Grown Stock: Container grown stock shall comply with the following:

1. Growing in container for minimum 30 days before delivery, with sufficient root system for

container size.

2. Not root-bound or with root systems hardened off.

D. Ground Cover Plants: Use only ground cover plants well-established in removable containers, integral containers, or formed homogenous soil sections.

E. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

F. Labeling: Label each plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant as shown on Drawings.

G. Annuals and Biennials: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery and that are in bud but not yet in bloom

H. Trees: Trees shall be nursery/tree farm grown. Collected and Grow Bag trees will not be accepted. Containerized trees shall be fully rooted in the container forming an intact root ball, but not root bound. Height spread and caliper shall be consistent with container size and nursery standards.

1. Minimum root ball sizes for all trees shall be as delineated within grades and standards for nursery plants, published by ANLA.

2.2 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:

1. Class: T, with a minimum of 99 percent passing through No. 8 sieve and a minimum of 75 percent passing through No. 60 sieve.
2. Class: O, with a minimum of 95 percent passing through No. 8 sieve and a minimum of 55 percent passing through No. 60 sieve.

B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Aluminum Sulfate: Commercial grade, unadulterated.

E. Perlite: Horticultural perlite, soil amendment grade.

F. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.

G. Sand: Clean, washed, natural or manufactured, and free of toxic materials.

H. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.

I. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.3 ORGANIC SOIL AMENDMENTS

A. Humus material shall have an acid-soluble ash content of no less than 5 percent and no more than 20 percent.

B. The pH of the material shall be between 6 and 7.5

C. The salt content shall be less than 10 millimho /cm at 25 degrees C on a saturated paste extract.

D. Boron content of the saturated extract shall be less than 1.0 part per million

E. Silicon content (acid-insoluble ash) shall be less than 50 percent.

F. Calcium carbonate shall not be present if the amendment is to be applied on alkaline soils.

G. Types of acceptable products are composts, manures, mushroom composts, peat mosses, etc., low in salts, low in heavy metals, free from weed seeds, free of pathogens and other deleterious materials.

H. Composted wood products are conditionally acceptable (stable humus must be present). Wood-based products are not acceptable which are based on redwood or cedar.

I. Sludge-based materials are not acceptable.

J. Carbon-nitrogen ratio shall be less than 25:1.

K. Compost shall be aerobic without malodorous presence of decomposition products.

L. The maximum particle size shall be 0.5-inch and 80 percent or more shall pass a NO.4 screen for mixing with soil.

M. Maximum total permissible pollutant concentrations in organic amendment in parts per million on a dry-weight basis:

1.	Arsenic:	20
2.	Cadmium:	15
3.	Chromium:	300
4.	Cobalt:	50
5.	Copper:	150
6.	Lead:	200
7.	Mercury:	10
8.	Molybdenum:	20

9.	Nickel:	100
10.	Selenium:	50
11.	Silver:	10

N. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1/2-inch sieve; and free of substances toxic to plantings.

O. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or granular texture, with a pH range of 3.4 to 4.8.

P. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent.

Q. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.

R. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

S. Potential Chemical Amendments Required by Accepted Amendment Program and Backfill Mix:

1. Ground Limestone: Agricultural limestone containing not less than 85 percent of total carbonate, ground to such fineness that 50 percent will pass No. I sieve and 90 percent will pass No. 20 sieve.

2. Dolomite Lime: Agricultural grade mineral soil conditioner containing 35 percent minimum magnesium carbonate and 49 percent minimum calcium carbonate, 100 percent passing No. 65 sieve.

3. Gypsum: Agricultural grade product containing 80 percent minimum calcium sulfate.

4. Iron Sulfate (Ferric or Ferrous): Supplied by a commercial fertilizer supplier, containing 20 to 30 percent iron and 35 percent to 40 percent sulfur.

5. Sulfate of Potash: Agricultural grade containing 50 to 53 percent of water-soluble potash.

6. Single Superphosphate: Commercial product containing 20 to 25 percent available phosphoric acid.

7. Ammonium Sulfate: Commercial product containing approximately 21 percent ammonia.

8. Ammonium Nitrate: Commercial product containing approximately 34 percent ammonia.

9. Calcium Nitrate: Agricultural grade containing 15-1/2 percent nitrogen.

10. Urea Formaldehyde: Granular commercial product containing 38 percent nitrogen.

11. IBDU (Iso Butyldiene Diurea): Commercial product containing 31 percent nitrogen.

12. Soil Sulfur: Agricultural grade sulfur containing a minimum of 96 percent sulfur.

13. Silicic Acid Calcium: Commercial grade.

14. Polymeric Soil Conditioner: 20 to 25 percent anionic polyacrylamide, water-soluble,
15. Linear, 7,500,000-dalton, soil aggregating polymer containing a minimum of 20,000
16. Soil binding sites proven to be efficacious.

2.4 FERTILIZERS

A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast-and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.

B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
2. Commercial fertilizer: Osmocote Plus, (15-9-12) stock no. 90328, controlled release fertilizer, by Scotts-Sierra Horticultural Products, (800)-492-8255. Apply 30 lbs. of Osmocote per 1,000 SF unless otherwise recommended by testing laboratory.
3. Submit adjusted fertilizer analysis for plant type as may be required (i.e. soil, shrubs/groundcovers, and trees).
4. Fertilizer Tablets: 21 gram, (20-10-5) Agriform brand tablets by Sierra Chemical Company

2.5 PLANTING SOIL

A. Planting Soil Mixes: Refer to the Plant Schedule.

B. Mixing:

1. Blend materials in a clean area which will not contaminate mix.

2. Do not mix in planting areas.

2.6 SOIL CONDITIONERS

A. Soil conditioners shall be as specified in Section 329113 -Soil Preparation.

B. Supply and transport water to all landscape areas during construction until the irrigation system is installed and operational.

2.7 MULCHES

A. Types: Refer to the Plant Schedule.

2.8 GUYING AND STAKING MATERIAL

A. Stakes for Tree Support:

1. Material: Construction grade lumber, pressure treated pine.
2. Vertical Stakes: Nominal 2" x 4" x 8' long pressure treated pine and pointed at one end.
3. Stakes: Nominal 2" x 4" x 3' long pressure treated pine, and pointed at one end. Number 4 (½" diameter x 3' long) rebar may be used in lieu of 2" x 4" lumber.
4. All above grade 2"x4" stakes and braces shall be painted with one coat of Olympic stain. Stain and color to be approved by the Owner's Representative.

B. Guying wires: Annealed, galvanized iron or galvanized steel 10 gauge wire. Wire shall be flagged with white surveyor tape minimum 2 per guy wire, (one flag near ground level and one flag near the middle of the length of wire, above turnbuckle if used).

C. Hose:

1. Type: New 1" diameter 2-ply reinforced black rubber or plastic hose.
2. Minimum Length: 8 inches.

D. Turnbuckles:

1. Turnbuckles are required. Landscape Contractor shall be responsible for keeping taut all guyed plant material and for keeping flagging in place. One turnbuckle per guy wire is required.

2. Method of tightening guy wires to be approved by Architect.

3. Guying to be tightened as needed, but always within one day of when found necessary.

2.9 WEED-CONTROL BARRIERS

A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. minimum.

2.10 PESTICIDES

A. General: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

2.11 SOIL STABILIZATION

A. Stabilize grades by approved methods where necessary.

B. Stabilize all sloped areas greater than 3 to 1 and areas found to be required to reduce surface erosion by the Owner's Representative with erosion control fabric. Install erosion control fabric according to the manufacturer's instructions.

2.12 DRAINAGE GRAVEL

A. Gravel: River gravel of graduated sizes.

1. River gravel shall be no smaller than (1/2”) one half inch nor larger than one and one-half (1-1/2") in any direction.

2. Install river gravel to a minimum depth of 4-inches.
3. Gravel shall be washed clean and contain no chemical elements harmful to plant growth.

4. Coral or limerock shall not be used.

PART 3 –EXECUTION

3.1 INSPECTION

A. Verify that final grades and drainage have been established prior to the beginning of the planting operation.

B. Inspect trees, shrubs, and ground cover plants for injury, insect infestation, and trees and shrubs for improper pruning.

C. Do not begin planting of trees until deficiencies are corrected, or plants replaced.

3.2 LOCATION/STAKING

A. Stake out locations for plants and outline of planting beds on ground with spray paint.

B. Do not begin excavation until stake out of plant locations and plant beds are acceptable to the Architect.

C. The location of all plant materials shall be field staked prior to installation for Architect's approval

3.3 SURFACE PREPARATION

A. Inspect soil surface for sticks, oils, chemicals, plaster, concrete, and other deleterious materials.

B. Remove and dispose of the deleterious materials.

C. Excessively Compacted Areas:

1. Where soil has become compacted more than 75-percent maximum dry density per ASTM D 1557 rip soil to 4 inches below the depth of the excessive compaction.

D. Planting Pits and Trenches: Ensure adequate percolation of all planting pits.

1. Shape:

   a. Vertical sides and flat bottom. Tree pits shall have mounded bottoms to improve drainage as detailed.

   b. Plant pits to be square or circular.

   c. Plant trenches to be rectangular with squared corners.

E. Disposal of Excess Soil:

1. Use acceptable excess excavated topsoil to form watering berms around trees.

2. Dispose of additional excess soil at direction of Owner's Representative.

3. Dispose of unacceptable or unused excess soil offsite, or as directed by the Owner's Representative.

4. Finished grade shall be maintained to ensure proper surface drainage away from buildings. Excess soil generated by planting pits may not be spread over graded areas, except berms, or as directed by the Architect or Owner.

3.4 AMENDMENT INCORPORATION

A. Spread dry amendments evenly over surface of dry soil with a drop spreader.

B. Organic amendment and soil must be dry.

C. Incorporate amendments uniformly within top 6 to 8 inches of soil within a few hours after amendment application, except at areas within drip lines of existing trees to remain.

D. At areas within drip lines of existing trees to remain, incorporate amendments uniformly to 1 to 2-inch depth within a few hours after application.

E. Mechanically incorporate the amendments into the soil via a method that will not excessively compact the soil below incorporated amendments.

F. To activate polymeric conditioner, irrigate soil very slowly so that soil surface will not form a crust and until water penetrates 6-inch depth.

G. Allow soil to dry until stringiness disappears.

H. Prior to planting, re-till soil to a 6-inch depth at areas outside of drip lines of existing trees to remain and re-till soil to a 1 to 2-inch depth at areas within drip lines of existing trees to remain.

3.5 PLANTING AREA ESTABLISHMENT

A. Loosen sub-grade of planting areas to a minimum depth of 6 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply fertilizer directly to sub-grade before loosening.

2. Thoroughly blend planting soil.

3. Spread planting soil to a depth of 6 inches but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or sub-grade is frozen, muddy, or excessively wet.

B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

C. Planting Beds:

1. All planting beds shall be excavated and receive backfill of planting soil mix and meet required finished grade.

2. Bring all beds to smooth, even surface conforming to established grades after full settlement has occurred.

D. Test fill all tree pits and shrub beds with water before planting to assure that proper drainage and percolation is available.

1. Pits which are not adequately draining shall be excavated to a depth sufficient for additional drainage and backfilled with gravel.

2. No allowances will be made for lost plants due to improper drainage.

3. Replace warranted plants with same species, size, and specification at no cost to Owner

3.6 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.

1. Pit and Trench Sizes:

a. For Trees:

1) Depth: Minimum 2 ft. from finish grade and increased as necessary to accommodate planting ball or drainage and at least 6" planting soil backfill except for center area under root ball and 6" of clean coarse sand for additional drainage.

2) Width or Diameter: 2 ft. greater than diameter of planting ball (unless otherwise approved by Architect for special planting areas).

b. For Shrubs and Groundcovers: All shrub and groundcover beds shall be excavated and receive backfill of the specified planting soil mix.

3.7 TREE AND SHRUB PLANTING

A. Preparation: Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1.

1. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

B. Placement: Set stock plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.

1. Backfill: Use planting soil for backfill.

2. Balled and Burlapped Stock: After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.

3. Balled and Potted and Container-Grown Stock: Carefully remove root ball from container without damaging root ball or plant.

4. Fabric Bag-Grown Stock: Carefully remove root ball from fabric bag without damaging root ball or plant. Do not use planting stock if root ball is cracked or broken before or during planting operation.

C. Backfill: Place backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.

D. Planting Tablets: Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole. Use tablets as specified in 2.4.B.4.

E. Continue backfilling process. Water again after placing and tamping final layer of soil.

F. Planting on Slopes: Set plant so root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.8 TREE AND SHRUB PRUNING

A. Prune minimum necessary to remove injured twigs and branches, deadwood, and suckers. Pruning shall be done with regard to natural form of plant material or as directed by the Architect.

B. Prune trees and shrubs prior to delivery to site only under direction of Architect. [in accordance with ANSI A300…]

C. Monitor pruning cuts to ensure proper healing and to prevent insect/disease infestation.

D. Remove only dead, dying, or broken branches. Do not prune for shape.

E. Prune according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

F. Perform all specialized shearing and or pruning as directed by the Architect at no additional cost to the Owner

3.9 PLANTING

A. Preparation: Dig holes large enough to allow spreading of roots.

B. Placement: Plant each in a manner that will minimally disturb the root system but to a depth not less than two nodes.

1. Center plant in pit, pot/bowl, or trench.

2. Face for best effect, or as directed by Architect.

3. Set plant plumb and hold rigidly in position until soil has been tamped firmly around planting ball

C. Planting Soil: Use only planting soil specified for backfill.

1. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

2. Place sufficient planting soil under plant to bring top of planting ball to finish grade (top of tree/palm root balls shall not be set below finished grade).

3. Backfill pit or trench with planting soil in 9 in. layers and water each layer thoroughly to settle soil and work soil completely around roots and planting ball.

4. After soil settles fill pit with planting soil, water, and leave pit surface even with finish grade.

D. Topsoil Berm:

1. Construct a planting soil berm 6 in. above finish grade forming a watering basin with a level bottom around each tree.

2. Size: 2 ft. greater than diameter of planting ball.

3. Construct a planting soil berm 6" above finished grade for all planting beds on slopes per planting details.

4. Leave saucer for 3 months or as directed by Owner's Representative. At the end of 3 months re-grade area and re-mulch ½” out from trunk (or planting bed) for all plantings. Remove excess from basin and clean area. Replace any damaged plant material or sod at no cost to Owner.

E. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from

transplanting shock.

F. Balled Plants (B&B) and (WB&B):

1. All burlap shall be biodegradable type.

2. Place in pit on planting soil backfill material/drainage gravel that has been hand-tamped prior to placing plant.

3. Place with burlap intact so location of ground line at top of ball is same as at nursery where grown.

4. Remove binding at top 1/2 of planting ball and lay top of burlap back 6 in. For wire balled trees, remove wire from the top 1/3 of the ball (1/2" min.) after the tree has been stabilized by partially backfilling the planting pit.

5. Do not pull wrapping from under planting ball.

6. Do not plant if planting ball is cracked, broken or showing evidence of voids before or during planting process. Replace warrantied plants with same species, size, and specification at no cost to Owner.

G. Container Grown Plants:

1. Can/container Removal:

a. Cut cans on two sides with an acceptable can cutter.

b. Do not injure planting ball.

c. Do not cut sides on knockout cans.

d. Carefully remove plants without injury or damage to planting ball.

e. After removing plant. Superficially cut edge roots with knife on three sides. Note: Root bound plants shall not be accepted.

2. Dig planting holes to size as shown.

3. Hand place plants which are in containers less than one gallon in size.

4. Hand backfill and hand tamp leaving slight depression around bases of plants.

5. Do not cover top of root ball.

6. Water thoroughly for settlement and replace required planting soil.

3.10 FERTILIZER APPLICATION

A. After planting, apply granular fertilizer 3 months from first application. Schedule time of fertilization with Owner for verification of fertilization of plant materials.

B. Apply granular fertilizer to planting bed and saucer areas around each tree and shrub at the following rates:

1. Trees:

a. Caliper 4 in. and larger: 2 lbs. per inch of caliper (i.e., 4" caliper equals 8 lbs. of fertilizer).

b. Caliper under 4 in.: 1 lbs. per inch of caliper (i.e., 3" caliper equals 3 lbs. of fertilizer).

2. Shrubs (plants greater than 24” o.c.): 1/4 pounds per plant.

3. Ground Cover Plants (plants 24" O.C. or less): 2 lbs. per l00 sq. ft. of area

K. Broadcast under foliage canopy and incorporate into soil.

D. Water immediately until root structure of plant is wet. Assure protection from fertilizer burn.

3.11 MULCHING AND GRAVEL

A. Top mulch planting pits, trenches, and areas within two days after planting

B. Mulch backfilled surfaces of planting areas and other areas indicated.

C. Cover watering basin or bed evenly with 2 inches compacted depth of top mulch material

D. Place gravel in areas indicated.

E. All trees not in planting beds shall be top mulched with an even 3" layer of mulch.

G. Water thoroughly, immediately after mulching.

F. "Cut in" mulch at plant bed/sod line.

G. Hose down planting area with fine spray to wash leaves of plants at least twice a week, or as required.

J. Exclude mulch from annual beds.

3.12 GUYING AND STAKING OF TREES

A. Staking

1. Guy all trees as shown on the drawings (except in approved locations where guying is not feasible).

2. Stake Installation:

a. Drive stakes perpendicularly, 3 ft. into ground at edge of root ball. Do not drive stake through soil separator or drainage gravel if present. Do not drive stakes through root ball.

b. Provide number of stakes indicated.

3. Tying and Cross-Bracing:

a. For trees 3" or greater in caliper: Stake and guy per details. Stake and tie firmly with guy wire as indicated. Separate guy wire from bark by hose section. Tie tree to cross-brace guy wire. Separate guy wire from bark by hose section.

b. For multi-trunk trees: Stake and guy per details. Stake and tie firmly with guy wire as indicated. Separate guy wire from bark by hose section. Tie tree to cross-brace guy wire. Separate guy wire from bark by hose section.

c. For Palm Trees: Stake palm trees as shown. Contractor shall not deepen the burial of Sabal Palmetto for stabilization in lieu of staking. The clear trunk height shall be required as specified on plans after installation. The Contractor shall be responsible for and guarantee the installation against toppling and be responsible for any and all damage incurred by toppling over of palms.

B. Guying

1. For large trees (3" or greater in caliper): Guy per details. Guy trees as shown on the drawings except where they are planted in special locations where guying is not feasible.

3.13 PLANT MAINTENANCE

A. Begin daily maintenance immediately after each item is planted and continue until substantial completion of the project. The Owner's responsibility for landscape maintenance shall commence on the date the project is determined to be substantially complete.

B. Maintain a healthy growing condition by pruning, watering, cultivating, weeding, mowing, mulching, tightening, and repairing of guys, resetting plants to proper grades or upright position, restoration of plant saucer, and furnishing and applying such sprays as necessary to keep planting free of insects and diseases.

C. The root system of plants shall be watered by the contractor as often as conditions require at such intervals as will keep the surrounding soil in best condition for promotion of root growth and plant life. Supplemental hand watering above the irrigation system watering as required until all plant materials are well established and/or the irrigation system is functioning properly.

D. Keep planting saucers and beds free of weeds, grass, and other undesired vegetation growth. All areas must be 98% weed free upon final acceptance by Owner.

E. Protect planting areas and plants against trespassing and damage of any kind for the duration of the maintenance period.

F. Inspect plants at least once a week and perform any required maintenance promptly. Replace impaired or dead plants minimum 2 weeks. Do not wait until near the end of the guarantee period to make replacements of plants which have become unacceptable.

G. Remove soil ridges from around watering basins prior to end of maintenance period, as directed

by the Architect.

H. Water when soil moisture is below optimum level for best plant growth. Coordinate and adjust timing of irrigation system with irrigation contractor as plant materials establish. Provide additional water as may be required above what is supplied by the irrigation system until all trees are well established.

I. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.

J. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

K. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use practices to minimize the use of pesticides and reduce hazards.

L. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

M. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

3.14 WEED CONTROL

A. Apply post-emergent herbicide, ~~"Roundup" as manufactured by Monsanto Corp. or approved equal,~~ per manufacturer's rate and method of application to all landscape bed areas as necessary. Roundup by Monsanto is not acceptable.

B. Apply pre-emergent herbicide "Surflan" before mulching and again as necessary throughout required maintenance period to prevent weed seed germination.

C. Verify that the herbicide and application technique will not damage plant material prior to application, and shall replace, and/or repair damage to any plant injured by herbicide application at no cost to the Owner

3.15 CLEANING

A. Fill all pits/depressions in holding area and rough grade to meet surrounding elevations.

B. Remove any organic or other debris resulting from the plant relocation process.

C. Sweep and wash all paved surfaces.

D. Remove planting debris from project site and holding area.

E. Remove soil conditioners, soil mixes, gravel, etc. from project site and holding area.

3.16 INSPECTION

A. Inspection of the entire project or designated portions will be made upon written request of the Contractor. At that time, if all work is satisfactory and complete according to the conditions of the Contract, the Architect will declare the work substantially complete.

B. Contractor's written request for review of the work or any designated portion thereof shall be received by Architect at least seven (7) days before anticipated date of inspection.

C. Plants that have died or are in unhealthy or badly impaired condition on inspection shall be treated or replaced within 14 days at no additional cost to Owner.

D. Replace rejected plants within two weeks of inspection.

E. Substantial completion of the work for the entire project or designated portions will constitute the beginning of warranty period.

F. Maintenance, as part of the work of this Section (exclusive of replacement within warranty period), will terminate on date the entire project or designated portion is declared substantially complete by the Architect/Owner.

END OF SECTION

3.1 PRE-CONDITIONING / PLANT ACCLIMATION

A. General: Plants shall be properly prepared for existence within the project premises by acclimatizing them to light, moisture, humidity, and fertilization levels in conformance with accepted industry standards for a period of not less than 120 to 180 days before installation.
   1. Plants that have been field grown and recently planted ARE NOT ACCEPTABLE.
   2. Provide certification from plant nursery supplier that plants have been acclimated for the specified time frame

3.2 EXAMINATION

A. General: The Architect may inspect all plants and plant materials at the place of growth or at the site before installation for compliance with requirements for genus, species, variety, size, and quality.
   1. The Architect shall have authority to further inspect all plants and plant materials for size and condition, including root ball size and system, insects, injuries and latent defects, and to reject unsatisfactory or defective plants and plant materials at any time during the progress of the Work. Remove rejected materials immediately from the project site.

3.3 PREPARATION

A. General: All plant material shall be thoroughly cleaned before arrival at the site.

B. At the completion of installation, all plants are to be thoroughly washed and cleaned of all planting dust and residues.

C. Do not prune trees and shrubs before delivery. Do not bend or bind-tie trees or shrubs in such a manner as to damage bark, break branches, or destroy the natural shape of the plant.

D. Provide protections necessary to prevent damage to existing interior and exterior finish materials including flooring and wall coverings. Protect furniture and other elements of interior furnishings as directed by the Program Manger. Restore damaged finishes or replace furnishings immediately and completely to the satisfaction of the Program Manger.

3.4 INSTALLATION

A. General: Planting procedures and methods shall be in conformance with accepted industry practices and with referenced publications.

B. Label at least one tree and one shrub of each variety with a securely attached waterproof tag bearing legible designation of botanical and common name.

C. Place rigid insulation infill as necessary to set plants to elevations indicated and only as pre-approved in writing by the Architect's landscape architectural consultant.

D. Locate plants and shrubs as indicated on Drawings.

E. Place plants plumb and secure within planters or bed areas on top of pre-approved, well-draining structural fill stabilized to permanently support the future size and weight of fully grown plants

F. Treat plants and plant materials as needed for control of insect pests as conditions require. Comply with applicable local and federal regulations. Provide documentation of compliance for required treatments.

G. Immediately remove insect infested, diseased, mechanically damaged, vandalized, or other physically or visually undesirable plants and replace with acceptable materials as directed by the Architect.

H. Trimming and pruning of plants shall be done after installation. Do not bend or bind-tie trees or shrubs that results in damaged bark, broken branches, or destroys the natural shape of the plant. All plants shall be trimmed and shaped to provide the desired effect indicated. All pruning shall be in accordance with standard modern horticultural practice as approved by the Architect.

I. Polish both surfaces of leaves at time of installation by approved means. Refer to Section 12850 for ongoing maintenance.

J. Canopy trees, smaller trees, palms, foliage plants, and other plants shall be hand washed with a damp cloth or sponge to remove residues from foliage and stems.

K. Plants shall not be cut, scarred, or otherwise injured or damaged during cleaning. Replace damaged plants.

L. Water and fertilize plants as needed using best horticultural practice.

3.5 CLEANUP AND PROTECTION

A. General: Keep adjacent floor areas clean of planting materials. Treat, repair, or replace damaged plants or materials as directed by the Program Manager.
   1. All planters and areas containing planters shall be cleaned of all leaves, stems, weeds, and other debris resulting from installation.

B. Protect all plants stored at the site during installation from any and all damage, theft, or deterioration of health or appearance.

C. Work areas shall be cleaned of litter and debris at the close of each work day.

3.6 INTERIM INTERIOR PLANT MAINTENANCE

A. Maintain all plants in a healthy growing condition by pruning, watering, cultivating, weeding, mulching, resetting plants to proper grades or upright position, restoration of plant saucer, and furnishing and applying such sprays as necessary to keep planting free of insects and diseases.

B. Provide daily maintenance of interior plants during interim period from initial plant installation until Substantial Completion. Comply with requirements of General Conditions and Division 1 specifications.

C. Provide supplemental foliage cleaning during the interim plant maintenance period. Supplemental foliage cleaning shall include increased frequencies of spray washing to eliminate construction dust build-up not less than bi-weekly, or as deemed necessary by the Program Manager. Spray washing of plants shall be conducted after primary daytime construction activities and as coordinated with the Project construction schedule.

D. Tropical plant leaf cleaner shall be used for plant foliage per plant leaf cleaner per manufacturer's directions.

E. Protect planting areas and plants against trespassing and damage of any kind for the duration of the interim maintenance period. Project plant installation shall be phased over several months in accordance with the master Project schedule.

F. Take necessary precautions to protect the Work and plants in place or stored on site from damage by construction activities and existing site conditions.

G. Contractor is responsible for immediate documentation of by photography of construction activities that have or may cause permanent or irreparable damage to the plant materials or work in place. Such documentation shall be brought to the immediate attention of the Program Manager in writing within 24 hours of occurrence.

3.6 SUBSTANTIAL REVIEW

A. At the conclusion of the planting, the Landscape Architect will review the Work to determine acceptability.

B. All plants not in a healthy, growing condition as determined by the Landscape Architect shall be removed from the Project Site and promptly replaced with plants of the same kind and size and in the same manner as specified for the original planting, at no additional cost to the Owner.

C. Where Work does not comply with the requirements specified, promptly remove rejected work and replace with acceptable materials.

D. Remove rejected materials from the Project site.

END OF SECTION

SECTION 32 94 00 INTERIOR PLANTS

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. Live Plants
2. Soil Preparation
3. Mulch / Sphagnum Moss
4. Planter Fill Material
5. Landscape Maintenance

1.3 DEFINITIONS

A. Specimen Plants: Specimen plants are plants that meet the requirements specified in Grades and Standards for Nursery Plants, and in addition are exceptionally healthy, vigorous, well-shaped, densely foliated, symmetrical and well balanced, trained and favored in development producing an appearance that is unquestionably outstanding and superior in form.

B. Container Grown Plants: Container grown plants are plants established and maintained in containers, and are not excessively root-bound. Plant containers shall not have large roots growing from the container and shall not contain weeds.

C. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

D. Pests: Living organisms that occur where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

E. Planting Soil: Manufactured planting soil from the nursery that grew the plant material and that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

F. Injury; defined, without limitation, as any bruising, scarring, tearing, or breaking of roots, trunk, bark, branches or foliage which may lend to or result in permanent damage to plant health or significantly alter the desired aesthetics of the plant for which it was intended.

G. Dead Tree; is a tree that has died or that has been damaged or stressed to an advanced state of decline and has been determined to be so by the Landscape Architect

H. Certified Arborist; an individual with a current certification from the International Society of Arboriculture (ISA) or member of the American Society of Consulting Arborists trained and experienced in all aspects of proper tree care.

1.4 REFERENCES

A. International Society of Arboriculture (ISA) - 'Guide for Plant Appraisal 8th Edition 1992,' prepared by the Council of Tree and Landscape Appraisers (CTLA).

B. Standardized Plant names; as established by Hortus III.

C. 'Cabling, Bracing, and Guying Standards for Shade Trees,' as published by the National Arborist Association (NAA), 174 Rt. 101, Bedford, NH 03102.

D. ANSI: A300 - 'American National Standards for Tree, Shrub, and Other Woody Plant Maintenance - Standard Practices'. 1995.

E. ANSI Z60.1 - American standards for Nursery Stock as approved by the American Association of Nurseryman, latest version.

1.5 SUBMITTALS

A. Submit for Owner's approval within 30 days after award of contract and prior to any start of work

B. Submittals shall comply with General Requirements.

C. Bill of Lading (BOL or B/L): Provide a Bill of Lading for each shipment of plants and materials. The BOL shall clearly show the shipper's name, the carrier's name, the buyer's name, and the complete address of the delivery.

1. The BOL shall be stamped with the Nursery's State Inspection Stamp and shall also include a "Fire Ant Compliance Stamp."
2. The BOL shall indicate the number of pieces of each size of material (pot size), with a total number of pieces of all sizes tabulated at the bottom of the tally.

B. Inspection Certification: Include inspection certification of plants and plant materials.

C. Conditioning Certification: Include documentation indicating the calendar date each plant, or group of plants, were brought in from the field to a "controlled environment" or "shade house" for conditioning.

D. Compliance with Specifications: Approval of plants and plant materials before ordering does not preclude right of inspection and rejection of materials during process of work nor does it relieve the Contractor of responsibility for correctness of species and physical condition of delivered plants and materials.

D. Product Data for each type of product indicated, including soils.

E. Mulch: 1-quart volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.

F. Plants: Contractor shall furnish all plant material indicated on Drawings. Any and all substitutions due to unavailability shall be requested in writing prior to confirmation of ordering.

1. Submit the following for the Landscape Architect's approval within 30 days after award of contract and prior to any start of work.

2. Documentation listing all required plant material by size, source, and quantity. Sort list by construction zone sequence if applicable.

3. Provide a 8 inch x 10 inch photos representative of each tree, shrub, vine, and groundcover species and each individual specimen tree or palm. Clearly label each photo with nursery source, plant name, container size and general width, height and caliper of plant.

G. List of proposed equipment to be used for tree planting and plan for plant storage on-site.

H. Qualification Data: For qualified landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

I. Certificate of Inspection: Provide certificate of inspection of plant materials by State Authorities.

J. Grower's Certification: Provide certification stating requirements for root pruning and holding plant stock at the nursery and plant shade acclamation.

K. Maintenance Instructions: Furnish three copies of written maintenance instructions to the Owner's Representative for installed plants throughout their full growing season.

L. Project Schedule: Provide five (5) copies of a comprehensive project schedule indicating proposed work and installation schedule. Schedule shall include breakdown for site preparation and fine grading, watering, trees, shrubs, groundcovers, sod/seed, and final clean-up.

1. Proposed schedule and sequence of work plan for all planting operations, with start dates and completion dates for planting trees, shrubs and groundcovers.

2. Include project "milestone dates" for designated project areas within the total project area as required including substantial completion dates.

3. All major changes in work schedules require a revised schedule indicating changes and milestone dates affected.

1.5 SUBMITTALS – CLOSEOUT

A. Record Drawings: After completion of the Work, the Contractor shall either update prints of the original plan, in a legible manner, or may re-draw, on tracing media, the entire landscape site indicating all changes or modifications to the original plan. The Contractor shall furnish a minimum of three copies of "Record Drawings" to the Owner.

1.6 REFERENCE STANDARDS

A. General: Comply with applicable provisions of the following:

1. ANSI Z60.1-1980; American Association of Nurserymen, American Standard for Nursery Stock.
2. "The Manual for Cultivated Plants" by L.H. Bailey.
3. "Hortus Second" by L.H. Bailey.
4. FNGA Standards.
5. ALCA Standards.

1.7 QUALITY ASSURANCE

A. The Contractor shall be responsible for all certificates of inspection of plant materials that may be required by Federal, State, or other authorities to accompany shipments of plants.

B. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful establishment of plants with a minimum of seven (7) years' experience in interior landscape installation in addition to requirements in Division 01 Section "Quality Requirements."

C. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

D. Pesticide Applicator: State licensed, commercial.

E. Quality Standard: All plants shall conform to the varieties specified in the Plant Schedule. No substitution of varieties or colors will be allowed without prior written approval of the Program Manager.

1. All plant materials not listed by "Grades and Standards for Nursery Plants", shall conform to the highest standards as to (1) health and vitality, (2) conditions of foliage, (3) root system, (4) freedom from pest or mechanical damage, (5) heavily branched and densely foliated according to accepted normal shape of the species.

F. Inspection Certification: Plants and materials shall be inspected by the Florida State Department of Agriculture.

1. Ship interior landscape materials with certificates of inspection required by governing authorities. Comply with regulations applicable to landscape materials.

G. Plant Labels: Each plant (piece) shipped shall have a complete label attached. Labels shall be durable, legible, and printed in weather resistant ink or equal print media. Labels shall include the plant name and container size for the purpose of inspection and planting identification. Labels shall be securely attached to each plant, bundles, or containers.

H. Substitutions: Plant material substitutions are not allowed. If a specified landscape material is not obtainable, submit proof of non-availability to the Landscape Architect, together with a proposal for use of equivalent material; comply with Division 1: General Conditions.

I. Unless otherwise stated herein, plants shall be shade-grown and habituated for interior use in accordance with standards set forth by FNGA.

J. Scientific and Common Names: Scientific and common names used for the plants indicated are generally in conformance with the approved names given in "The Manual for Cultivated Plants" by L.H. Bailey and in "Hortus Second" by L.H. Bailey. The names of varieties not included are generally in conformance with the names accepted in the nursery trade.

K. Plant specimens shall be field tagged by the Landscape Architect and shall have original plastic tag or band in place at time of review for Substantial Completion.

L. Plant Materials

1. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1
2. All plant material shall meet or exceed Florida Department of Agriculture and Consumer Services' Grades and Standards, "Florida Fancy" grade.
3. All plant material shall be containerized in standard nursery pots and boxes.
4. All plant material shall be shade acclimated for a minimum period of 120 days prior to shipping to the project. Contractor shall submit to the Landscape Architect a letter certification from the nurseries furnishing the plant material that all plants were shade acclimated for the period stipulated.
5. Furnish plant materials certified by State Department of Agriculture to be free from harmful insects or apparent disease. Verify that all plant material is free of harmful insects and disease. Inspection by State Department of Agriculture shall at the growing site.
6. All plant material shall be received in a healthy condition, free from pests and disease. Plants delivered to Contractor that are found to be damaged, root bound, diseased or distressed shall be brought to Owners' attention prior to accepting delivery.
7. Pre-selection and tagging of plant material by Owner Representative is to meet design intent only and does not constitute any guarantee by Owner of the selected plants. Health and vigor of plant material shall remain the sole responsibility of Contractor.
8. Owner reserves the right to have plant samples analyzed at any time to verify health and conformity to Specifications. Furnish samples upon request. Testing to be done by Owner's designated laboratory.
9. Cost of testing plant samples will be responsibility of Contractor. Lab fees for testing found to be negative will be reimbursed by Change Order to the Contract.
10. Rejected material shall be promptly removed and replaced at no cost to Owner.
11. Inspection and tagging at growing site does not preclude right of rejection at project site.

M. Pre-installation Conference: Conduct conference at Project site.

1.8 SHIPPING

A. General: Plants and planting materials shall be shipped using a responsible, properly equipped carrier. The carrier shall have transport vehicles properly equipped for shipment of specified plants and planting materials. Trucks shall have recording thermographs to ensure proper temperatures are maintained in the truck at all times.

B. Provide shipping instructions and recommendations, and any special handling requirements to the carrier for proper transport.

C. Coordinate with the Grower to ensure plants are shipped with the proper soil moisture content to allow the plants to sustain the strain of a long trip.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Transport all plants and planting materials in enclosed and environmentally controlled vehicles.

1. Products requiring shipping in open trucks shall be completely wrapped and protected against damage and weather conditions.

B. Handle plants and plant materials to prevent damage or contamination.

C. Protect plants and plant materials stored at the Project Site from adverse environmental conditions, any and all damage, theft, or deterioration of health and appearance during all delivery, storage, and handling.

D. Maintain and care for all plants installed or temporarily stored at the project site. Maintain plants in accordance with Section 329450. Remove and replace plants as specified.

E. Protect plants from construction damage, drying out, and other injury at all times.

F. Preparation for Delivery:

1. Prune head and/or roots of all trees per ANSI A300 Standards as required to assure safe loading, shipment and handling without damaging the natural form and health of the plant.

G. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

H. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, protect plants and trees from weather and mechanical damage, and keep roots moist.

I. Handle planting stock by the container.

J. Notify Owner and Landscape Architect of delivery schedule in advance so plant material may be inspected upon arrival at job site

K. Protect all plant materials during transport/delivery with shade cloth or other acceptable means to prevent wind burn.

L. Storage:

1. Protect roots of all plant material from drying or other possible injury. Keep plant root ball and crown moist at all times.

2. Store plants in shade and protect from weather. Heel in trees in a vertical position. Irrigate all stored plants as required.

3. Maintain and protect plant material not to be planted within four hours.

M. Handling

1. Do not drop plants.
2. Do not pick up container by stems or trunks.
3. Do not use chains or cables on any trees. Handle using nylon straps, 2" width minimum.
4. Protect all plant material during delivery to prevent damage or desiccation to root ball or desiccation of crown and leaves.

N. Mist periodically each day all tree root balls and crowns/tops during delivery, handling, and storing on site to ensure against drying.

O. Remove unacceptable plant material immediately from job site.

1.10 PROJECT CONDITIONS

A. Perform actual planting only when building atria structure, site elements, and soil conditions in the Atria are suitable for installation of plant materials.

B. Locate underground utilities and other non-readily-visible structures before digging per Project records. Repair damage to underground utilities and other construction.

C. Protect in-place construction against damage during work of this Section.

D. Protect installed planting work during construction period and maintenance period. Protections are subject to approval by Architect.

E. Notify Architect minimum 2 weeks before start of installation.

1.11 WARRANTY

A. Warrant plants against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by Owner, or incidents that are beyond Contractor's control.

1. Warranty Period: One year from date of Substantial Completion.
2. Replace dead or unhealthy plants within 2 weeks of rejection and warrant replacement plants for one year from date of installation.

B Replacement plants under this guarantee shall be replaced within (2) two weeks of rejection and guaranteed for one (1) year from date of replacement installation

C. Repair damage to other plants, lawn or construction work during plant replacement at no cost to the Owner (this includes, but is not limited to, damage to curbs, walks, roads, fences, site furnishings, etc.).

PART 2 -PRODUCTS

2.1 PLANT SCHEDULE

A. General: The species, size, and manner in which plants are to be furnished is indicated in the Plant Schedule.

1. Indicated dimensions are minimum acceptable sizes.

B. Specimen Plants: Where specimen plant material is indicated, approval from the Architect is required before acquiring the material. The Architect may tag the specimen material, or require photographs of such plants demonstrating their size, quality, character, or any other characteristic essential to plant description as requested by the Architect.

C. Particular care shall be exercised in the binding and wrapping of such specimens to ensure safe loading, shipment and handling for the entire operation of transportation, from growing location to the placement locations indicated.

2.2 LIVE PLANT MATERIALS

A. Provide containerized nursery grown trees and shrubs, grown in a recognized nursery in accordance with good horticultural practice, with healthy, well-developed root systems developed by transplanting or root pruning.

B. Plants shall be typical of their species or variety and shall have a normal habit of growth.

C. No plants will be acceptable which require permanent staking in order to maintain an upright position. Temporary staking is permitted in accordance with planting details.

D. Plants shall be sound, healthy and vigorous, well-branched and densely foliated.

E. Plants shall be visibly free of pests and pathogens which could, by their presence, induce (or contribute to) the decline of the plant

F. Plants shall be free of chlorosis, yellowing or poor chlorophyll formation, disease, insect pests, eggs or larvae. Plants shall be turgid and substantially erect.

G. Plants shall be reasonably free of conspicuous scarring evidence. Scars, conspicuous or not, must be substantially healed, providing no point of entry for deleterious pathogens or boring insects. There shall be no splitting of canes or trunks at branching points.

H. Plants shall be free from defects, decay, disfiguring roots, abrasions of the bark, or objectionable disfigurements.

I. Canes or trunks shall be well formed, sturdy and well rooted, stable and self-supporting in the growing container.

J. All plant foliage shall be free of mechanical and pest injury, dust, dirt, and chemical or foliage sprays and polishes, water residues, and liquids affecting the appearance or health of plants.

K. The root systems shall be well-developed and upon inspection, shall be visibly free of pests and pathogens. Development shall be adequate to:

1. Be well distributed throughout the container, such that the roots visibly extend on all sides to the inside face of the growing container. Conversely, the root formation within the container shall not have developed to the point where it becomes excessive (i.e., "pot-bound" or "root-bound") and prohibits water from permeating to the fine water-absorbing root hairs.

2. Afford firm support and ensure physical stability of the plant parts above the soil.

3. Maintain life systems required to produce vigorous, healthy growth.

L. Plant Size: Provide trees and shrubs of the sizes indicated, and in accordance with dimensional relationship requirements of ANSI Z60.1 for kind and type of trees and shrubs required.

1. Minimum acceptable size of all plants, measured before pruning and with branches in normal position, shall conform to the dimensions indicated in the Plant Schedule. Larger plants of equal quality may be accepted at no additional cost to the Owner.

2. Over-all plant height shall be measured from the bottom of growing containers to the mean foliage top in accordance with interior plant industry standards.

3. Width shall be measured across mean foliage not including random outstanding branches. Foliage origin along a main trunk, cane or stem, shall be measured from the soil line.

M. Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule.

N. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. All plants shall be grown under climatic conditions similar to those in location of project.

2. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots will be rejected.

D. Container Grown Stock: Container grown stock shall comply with the following:

1. Growing in container for minimum 60 days before delivery, with sufficient root system for container size.

2. Not root-bound or with root systems hardened off.

2.3 ARTIFICIAL TREES

A. For artificial trees refer to section 12 92 33 Interior Trees

2.4 SOIL MIX

A. Growing Medium: The growing medium shall be Success Soil Select (Cialbrie) or accepted Substitution and shall provide:

1. Thorough drainage and satisfactory aeration of the root zone. The soil mass should be as uniform as possible.
2. Adequate moisture and nutrient retention as may be necessary to promote vigorous but controlled plant growth.
3. Sufficient bulk density in the growing container to ensure stability of the entire unit, that is, plant and container.

B. The growing medium shall be free of pests, pathogens, and weeds.

C. The growing medium shall be free of chemical residues which could be harmful to persons who come in contact with, or are in proximity to, the planted areas.

D. The pH of the medium shall be amended using horticulturally accepted methods to a value of 6.5 to 6.8 unless otherwise stipulated to suit specific varieties.

E. The growing medium shall not exceed 30 lb. per cubic foot at field/container capacity and shall be a light, airy, well-draining soil mix WITHOUT perlite.

F. Unless specific plant requirements dictate otherwise, a consistent mix shall be used throughout the entire project.

G. Add time-release fertilizer 14.14.14 not to exceed 3 lb. per cubic yard to the growing medium at time of mixing; Nutricote or equal.

2.5 ACCESSORIES

A. Double Sleeve Pots - Plant Container Sleeves: Blow-molded plastic, "grow-type" pot.
   1. Size: Provide plant pots one-size larger than plant container size indicated.

B. Drainage Gravel; Stay-Rite Filler Material; Gravel Fill Material: Locally available, lightweight aggregate, clean, free of foreign substances, earth tone colors, screened washed and void of sand, weeds, loam, or extraneous material.
   1. Product and Manufacturer: Solite #124; Florida Solite Company.
      a. Size: 1/2-inch diameter down to #4 size.
      b. Weight: Approximate weight 1350 pounds per cubic yard.
      c. Color: Dark brown.

C. Water: Potable.

D. Spanish Moss Mulch: 100% pure Spanish moss (*Tillandsia usneoides*): soil cover to be used as top dressing over pots plants, natural color.

E. Rigid Insulation Infill - Rigid Styrofoam: Extruded polystyrene foam insulation - ASTM C 578, Type VII – Standard Specification for Rigid Cellular Polystyrene Thermal Insulation.
   1. Use for blocking under plants
   2. Density: 60 pounds per square inch, minimum.
   3. Product and Manufacturer: Styrofoam Brand Plazamate 60 High Load Insulation; The Dow Chemical Company or approved equal.

F. Coarse Sand: Suitable for plant growth. Do not use beach sand.

G. Peat: Not to exceed 10% of total volume.

H. Plant leaf cleaner: Leaf-Tek Pro Leaf Cleaner by Leaf-Tek, 800-350-5323, www.leaftek.com, or approved equal. Use per manufacturer's directions.

PART 3 –EXECUTION

3.1 PRE-CONDITIONING / PLANT ACCLIMATION

A. General: Plants shall be properly prepared for existence within the project premises by acclimatizing them to light, moisture, humidity, and fertilization levels in conformance with accepted industry standards for a period of not less than 120 to 180 days before installation.
   1. Plants that have been field grown and recently planted ARE NOT ACCEPTABLE.
   2. Provide certification from plant nursery supplier that plants have been acclimated for the specified time frame

3.2 EXAMINATION

A. General: The Architect may inspect all plants and plant materials at the place of growth or at the site before installation for compliance with requirements for genus, species, variety, size, and quality.
   1. The Architect shall have authority to further inspect all plants and plant materials for size and condition, including root ball size and system, insects, injuries and latent defects, and to

reject unsatisfactory or defective plants and plant materials at any time during the progress of the Work. Remove rejected materials immediately from the project site.

3.3 PREPARATION

A. General: All plant material shall be thoroughly cleaned before arrival at the site.

B. At the completion of installation, all plants are to be thoroughly washed and cleaned of all planting dust and residues.

C. Do not prune trees and shrubs before delivery. Do not bend or bind-tie trees or shrubs in such a manner as to damage bark, break branches, or destroy the natural shape of the plant.

D. Provide protections necessary to prevent damage to existing interior and exterior finish materials including flooring and wall coverings. Protect furniture and other elements of interior furnishings as directed by the Program Manger. Restore damaged finishes or replace furnishings immediately and completely to the satisfaction of the Program Manger.

3.4 INSTALLATION

A. General: Planting procedures and methods shall be in conformance with accepted industry practices and with referenced publications.

B. Label at least one tree and one shrub of each variety with a securely attached waterproof tag bearing legible designation of botanical and common name.

C. Place rigid insulation infill as necessary to set plants to elevations indicated and only as pre-approved in writing by the Architect's landscape architectural consultant.

D. Locate plants and shrubs as indicated on Drawings.

E. Place plants plumb and secure within planters or bed areas on top of pre-approved, well-draining structural fill stabilized to permanently support the future size and weight of fully grown plants

F. Treat plants and plant materials as needed for control of insect pests as conditions require. Comply with applicable local and federal regulations. Provide documentation of compliance for required treatments.

G. Immediately remove insect infested, diseased, mechanically damaged, vandalized, or other physically or visually undesirable plants and replace with acceptable materials as directed by the Architect.

H. Trimming and pruning of plants shall be done after installation. Do not bend or bind-tie trees or shrubs that results in damaged bark, broken branches, or destroys the natural shape of the plant. All plants shall be trimmed and shaped to provide the desired effect indicated. All pruning shall be in accordance with standard modern horticultural practice as approved by the Architect.

I. Polish both surfaces of leaves at time of installation by approved means. Refer to Section 12850 for ongoing maintenance.

J. Canopy trees, smaller trees, palms, foliage plants, and other plants shall be hand washed with a damp cloth or sponge to remove residues from foliage and stems.

K. Plants shall not be cut, scarred, or otherwise injured or damaged during cleaning. Replace damaged plants.

L. Water and fertilize plants as needed using best horticultural practice.

3.5 CLEANUP AND PROTECTION

A. General: Keep adjacent floor areas clean of planting materials. Treat, repair, or replace damaged plants or materials as directed by the Program Manager.
   1. All planters and areas containing planters shall be cleaned of all leaves, stems, weeds, and other debris resulting from installation.

B. Protect all plants stored at the site during installation from any and all damage, theft, or deterioration of health or appearance.

C. Work areas shall be cleaned of litter and debris at the close of each work day.

3.6 INTERIM INTERIOR PLANT MAINTENANCE

A. Maintain all plants in a healthy growing condition by pruning, watering, cultivating, weeding, mulching, resetting plants to proper grades or upright position, restoration of plant saucer, and furnishing and applying such sprays as necessary to keep planting free of insects and diseases.

B. Provide daily maintenance of interior plants during interim period from initial plant installation until Substantial Completion. Comply with requirements of General Conditions and Division 1 specifications.

C. Provide supplemental foliage cleaning during the interim plant maintenance period. Supplemental foliage cleaning shall include increased frequencies of spray washing to eliminate construction dust build-up not less than bi-weekly, or as deemed necessary by the Program Manager. Spray washing of plants shall be conducted after primary daytime construction activities and as coordinated with the Project construction schedule.

D. Tropical plant leaf cleaner shall be used for plant foliage per plant leaf cleaner per manufacturer's directions.

E. Protect planting areas and plants against trespassing and damage of any kind for the duration of the interim maintenance period. Project plant installation shall be phased over several months in accordance with the master Project schedule.

F. Take necessary precautions to protect the Work and plants in place or stored on site from damage by construction activities and existing site conditions.

G. Contractor is responsible for immediate documentation of by photography of construction activities that have or may cause permanent or irreparable damage to the plant materials or work in place. Such documentation shall be brought to the immediate attention of the Program Manager in writing within 24 hours of occurrence.

3.6 SUBSTANTIAL REVIEW

A. At the conclusion of the planting, the Landscape Architect will review the Work to determine acceptability.

B. All plants not in a healthy, growing condition as determined by the Landscape Architect shall be removed from the Project Site and promptly replaced with plants of the same kind and size and in the same manner as specified for the original planting, at no additional cost to the Owner.

C. Where Work does not comply with the requirements specified, promptly remove rejected work and replace with acceptable materials.

D. Remove rejected materials from the Project site.

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.

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 or problem areas in the lines televised. Video playback shall beat 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 333900.

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

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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 05 22 – MICROTUNNELING FOR FUEL 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. This Section includes requirements for designing and installing fuel pipeline casing systems beneath runways, taxiways, and other terrain utilizing microtunneling trenchless excavation methods. Such work consist of, but is not limited to, constructing required access pits, furnishing and installing tunnel casings and end caps, furnishing and installing casing spacer and insulators, providing necessary dewatering and monitoring of movement, to the limits indicated and in accordance with the Contract Documents.

B. Tunnels shall be constructed using microtunneling techniques, as indicated on the drawings. Contractor shall provide all labor, materials, equipment and technical support, and perform all operations necessary for the installation of casing pipe(s) using microtunneling techniques. Contractor shall include costs for labor, materials and equipment, and all necessary costs for safety training, supplies and services to protect existing facilities and personnel during complete microtunneling operations in accordance with local, state, and federal regulations concerning construction safety.

1.3 REFERENCE STANDARDS

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

1. American Petroleum Institute (API):
    a. 5L - Line Pipe.
    b. 13A - Drilling - Fluid Materials.
2. American Society for Testing and Materials (ASTM):
    a. A36/A36M - Standard Specification for Carbon Structural Steel.
    b. A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
    c. A139 - Electric-Fusion (ARC) -Welded Steel Pipe (NPS 4 and Over).
    d. C150 - Standard Specifications for Portland Cement.
3. American Welding Society (AWS):
    a. D1.1 - Structural Welding Code - Steel.
    b. D1.5 - Bridge Welding Code.
4. American Society of Civil Engineers

a. Standard Construction Guidelines for Microtunneling

1.4 QUALITY ASSURANCE

A. Material Requirements:

1. Casing pipe must be of adequate strength to withstand all loads imposed during and after construction including but not limited to:

a. Jacking loads.

b. Pulling loads.

c. Earth pressure (passive and active).

d. Surface live loads.

e. Overburden dead load.

f. Seismic loading.

g. Ground water pressure.

B. Installer Qualifications:

1. Engage an experienced Installer with at least ten (10) years' experience performing work of a similar nature to assume engineering responsibility and perform work of this Section who has specialized in constructing tunneling systems similar to those required for this Project and with a record of successful in-service performance.

2. Contractor's Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where the Project is located and who is experienced in providing engineering services for designing excavation support and protection systems that are similar to those indicated for this Project in material, design, and extent.

3. Contractor Engineering Responsibility: Engage a qualified professional engineer to prepare or supervise the preparation of data for the tunneling system including drawings and comprehensive engineering analysis that shows the system's compliance with specified requirements.

4. Microtunneling Superintendent Qualifications: The tunneling subcontractor shall provide a site superintendent with no less than 10 years relevant experience and a minimum of 3 similar projects successfully completed.

C. Maintain an ongoing Quality Assurance plan to verify that items related to microtunneling are being performed according to the Specifications and Drawings. Work shall be performed in the presence of the Owner's Authorized Representative, unless the Owner's Authorized Representative has granted permission in writing to perform such work in the Owner's Authorized Representative's absence. The Owner's Authorized Representative shall have access to view the microtunneling operation controls at all times with no restrictions.

D. Casing Pipe Testing:

1. Contractor shall submit a plan to leak test the casing pipe after installation is complete and prior to installing carrier pipes.

a. Contractor shall achieve leak testing by visually examining the interior of casing pipes for evidence of water infiltration through the casing pipe and its joints.

b. Immediately after casing pipe installation and prior to performing the leak test, the Contractor shall protect casing pipes from water entering via the open ends. If water enters the open ends of case pipes, the Contractor shall completely dry the interior of the casing pipes and restart leak testing.

c. Evidence of water or wet stains on the inside of the case pipes shall be considered a failed leak test. Leaks detected shall be repaired by field welding.

(1) Contractor shall submit to the Owner's Authorized Representative weld procedure specifications (WPS) for the repair welds and welder qualification records (WQR) for the welders completing the repairs.

(2) Repair welds shall undergo magnetic particle and dye penetrant testing as specified in SECTION 33 52 45.

(3) After successful testing of joint repair welds, the casing pipes shall be leak tested again until successful leak testing is achieved.

d. The minimum period for leak testing, from start to end, shall be a 48 hour period.

e. The first visual inspection of the casing pipe shall be immediately after the first 24 hours of the leak test.

f. After successful leak testing, Contractor shall prepare and submit an affidavit of successful leak testing prior to installing carrier piping, spacers, and conduits within the casing pipe.

2. Contractor shall submit a plan to pressure test the casing after carrier pipes have been installed and end caps have been welded in place and all water proofing seals installed.

E. Steel Pipe Welding Requirements:

1. All welding procedures used to fabricate the casing end caps to the steel casings shall be pre-qualified under the provisions of ANSI/AWS D1.1. Welding procedures shall be required for, but not necessarily limited to, fabricating casing end caps and joining end caps to casing.

2. All welding shall be done by skilled welders, welding operators, and tackers who have adequate experience in the type of materials to be used. Welders shall be qualified under the provisions of ANSI/AWS D1.1 by an independent local approved testing agency not more than six months prior to commencing work on the casing; unless having been continuously employed in similar welding jobs since last certification. Machines and electrodes similar to those used in the work shall be used in qualification tests.

3. Inspect welds visually in accordance with ANSI/AWS D1.1, Section 6, and Article 10.17.1.

1.5 DESIGN REQUIREMENTS

A. Microtunneling Pipe Casing: The casing shall be designed by a Contractor's engineer who is a licensed professional engineer. The casing shall be designed for the following loads and conditions:

1. Overburden Load and Static Water Level: Pipe shall be designed for an equivalent overburden load equivalent to final soil, rock, and water overburden pressures combined with appropriate surcharge loads relative to the depth of burial.

2. Surcharge Load: In addition to the load due to overburden, the pipe shall be designed to resist a minimum surcharge loading associated with expected traffic, aircraft, or other potential surcharges. Designed aircraft loading shall account for such loads anticipated for an A380 aircraft.

3. Jacking Loading: The liner pipe shall be designed to withstand the anticipated jacking load with a factor of safety of at least 1.5. The Contractor shall determine the jacking load.

4. Bending: The liner pipe shall be designed to withstand a bending-induced moment from a diameter change equivalent to 0.2% of the pipe diameter.

5. Buckling: The pipe design shall indicate adequate resistance to buckling forces.

6. Construction Loads: The pipe shall be designed to withstand a combination of handling, ground, pipejacking, and grouting loads. Design shall take into account irregular-loading conditions resulting from steering the pipe with the slurry machine.

7. Provide all design calculations for review.

B. Casing Spacers and Insulators: Casing spacers/insulators shall be designed to support the weight of the fuel pipes as if full of water and the weight of the electrical conduits and wiring.

C. Surface Settlement: Settlement prevention and monitoring shall be designed to prevent surface, ground, pavement, and existing utility settlement. If subsidence exceeds 0.5 inches at any time at any location above the microtunneling based upon elevation checks conducted by the Contractor's surveyor, the Contractor shall immediately cease microtunneling operations, notify the Owner's Authorized Representative, identify the source of subsidence, and take corrective action.

D. The Contractor shall conduct a geotechnical investigation of the area along the entire alignment of all microtunneling operations. Prior site soil investigation reports will be available to the Contractor. Interpretation of this material and making one's own investigation and determination of the work site soil conditions is the sole responsibility of the Contractor

1.6 ACTION SUBMITTALS

A. Qualification Data:

1. Firms and persons specified in "Quality Assurance" section shall demonstrate their capabilities and experience by including a list of at least three (3) completed projects of similar scope with project names and addresses, names and addresses of architects and owner, and other information specified.

B. Submittals:

1. Review of submittals by the Owner's Authorized Representative shall not in any way be considered to relieve Contractor from full responsibility for errors therein or from the entire responsibility for complete and adequate design and performance of the Contractor's installation system and final in-place pipe.
2. Submit the following Contractor's drawings:
   a. Shop drawings for casing pipe showing sizes, shapes, methods of attachment and connection details.
   b. Shop drawings for pipe spacers and end seals.
   c. Shop drawings for pipe alignment guides.
3. Submit Designs and Methods of Construction:
   a. Submit construction work area location plans to show the layout and dimensions of access shaft, equipment, above ground facilities, including slurry storage tanks, generator enclosures, and material laydown and staging areas for each tunnel.
   b. Manufacturer's literature describing in detail the microtunneling system to be used. Detailed descriptions of project on which this system has been successfully used, giving total pipe length, project duration, and number of restarts.
   c. Details of tunneling equipment shall be submitted included but not limited to:
      (1) Microtunneling Boring Machine and its basic data such as dimensions, thrust, power requirements, face control, steering control, lining installation and all other pertinent information.
      (2) Jacking system including proposed set-up within the pit, jacking force capacity, and operational requirements.
      (3) Installation of pipe including installation system, distance to machine/face, ground stabilization measures to maintain settlements within tolerances.
      (4) Alignment control and verification capabilities. Confirm that these systems can achieve the required pipeline line and grade within the specified tolerances.
      (5) Details of bentonite injection system used to lubricate the pipe during jacking, including injection port locations, injection pressures, proposed lubrication mix and sequence of installation.
      (6) Muck and slurry handling, transport, and disposal equipment and procedures including details of the slurry separation and recirculation systems, and the location of slurry and muck disposal sites. Provide written documentation from the disposal site(s) indicating that they will accept the muck or slurry and are in compliance with regulatory agencies having jurisdiction.
      (7) Working drawings of lighting, electrical, and ventilation systems that may be required at entrance and exit pits and within the tunnel structure.

d. Details of pipe to be used, including diameter, section length, wall thickness, material properties, fittings, joints, locations of lubrication ports, coatings and certificates of compliance with the requirements of all parts of this specification.

e. Submit signed and Contractor engineered sealed working drawings, engineering calculations and written procedure describing in detail the proposed microtunneling operation. This shall include but not be limited to the following:

(1) Sheeting, shoring, or excavation support for microtunneling sending and receiving shafts.

(2) Contractor engineered design calculations of casing pipe demonstrating that the pipe casing selected has been designed to support the maximum anticipated earth loads and superimposed live loads, both static and dynamic, which may be imposed on the pipe casing.

(3) Liner pipe joint design, joint details, and quality assurance methods. Details of the seals, and the methods to control groundwater flows and loss of soil into the shafts when breaking out of the jacking pit and breaking into the receiving pit.

(4) Design and details of casing pipe insulators/spacers demonstrating that they are capable of supporting the weight of the fuel pipes as if full of water and the weight of the electrical conduit and wiring.

(5) Design and details of casing pipe end caps.

(6) Describe method and capabilities for exerting a stabilizing pressure at the tunnel heading. Indicate range of face pressures anticipated to be required to stabilize the heading and the methods and equipment to be used to monitor and control pressures.

(7) Calculations showing the hydraulic pressure which is required to develop the maximum allowable jacking pressure. A description of controls to ensure that this hydraulic pressure will not be exceeded during jacking operations.

f. Calculations by Contractor's Engineer demonstrating that the soils behind the thrust block will sustain the maximum planned forces developed by the main jacks. Calculations by Contractor's Engineer showing pipe's strength (including joint contact stresses) and other components with adequate safety factor to withstand jacking pressures.

(1) Jacking frame and thrust block design, layout and details, including reaction transfer calculations.

(2) Submit all surface, ground, pavement, and existing utility settlement monitoring techniques and procedures used to avoid surface settlement and correct any settlement that may occur during microtunneling. Submit any anticipated surface and subsurface settlement values and the methods used to derive the settlements.

g. Describe proposed means and methods to locate utilities and assess utility conditions prior to tunneling and measures to assure protection of utilities during tunneling, in particular those close to the proposed tunneling (casing pipe) crown.

h. Microtunneling Work Pits:

(1) Provide details of support of excavation for all tunneling work pits. Include consideration of loads imposed by tunneling machines, pipe jacking equipment, and all other construction equipment operating in or near the work pits.

(2) Provide supporting calculations for the above.

i. Provide a narrative providing information on the execution of the microtunneling work including:

(1) Overall set-up of the tunneling work.

(2) Projected machine performance in ground conditions anticipated.

(3) Production rates and anticipated progress of work.

(4) Location and layout of additional borings proposed (if any).

(5) Dewatering system details; pipes, pumps, drainage pipes, discharge locations.

4. Submit Contingency Plan: At least 14 calendar days prior to the start of tunneling operations, the Contractor shall submit a Contingency Plan that defines the remedial measures to be implemented to stabilize the excavation if any geotechnical instrumentation reading exceeds the respective threshold or limit values listed in PART 3. As a minimum, the Contingency Plan shall include:

a. Name and qualification of personnel responsible for implementing Contingency Procedures.

b. Description of conditions considered to require remedial measures.

c. List of stand-by materials to be used for remedial measures and their immediate availability.

d. Method and list of stand-by equipment of implementation of remedial measures and their immediate availability.

e. Methods of verification of the successful implementation of remedial measures.

5. Submit certified test reports and/or manufacturers data for all casing materials to be used in tunnel construction before delivery of materials.

6. Boring Path Report: Furnish a Bore Path Report to the Owner’s Authorized Representative within 14 days of the completion of each bore path. Submit the As-Built-Plans to the Owner’s Authorized Representative within 30 calendar days.

7. Casing leak test plan prior to carrier pipe installation and pressure test plan after end caps have been welded and all appropriate seals have been made.

C. As-Built Plans: Provide the Owner’s Authorized Representative with a complete set of As-Built-Plans showing all tunnels within 30 calendar days of completion of the work.

Plans must be dimensionally correct copies of the Contract plans. Produce the plans as follows:

1. On the Contract plan view, show the centerline location of each facility, installed or installed and placed out of service to an accuracy within 1 inch at the ends and other points physically observed. Show the remainder of the horizontal alignment of the centerline of each facility installed or installed and placed out of service and note the accuracy with which the installation was monitored.
2. Provide a profile plan for each bore path. Also show the ground or pavement surface and the crown elevation of each facility installed, or installed and placed out of service, accurately to within 1 inch at the ends and other points physically observed. Show the remainder of the vertical alignment of the crown of each facility installed, or installed and placed out of service and note the accuracy with which the installation was monitored.
3. Show the crown elevation, diameter and material type of all utilities encountered and physically observed during the subsoil investigation. For all other obstructions encountered during subsoil investigation or the installation, show the type of material, horizontal and vertical location, top elevation and lowest elevation observed, and note if the obstruction continues below the lowest point observed.

D. Construction Records:

1. Survey notes, records, and shift installation reports indicating thrust forces, slurry flow rates, machine torque measurements, laser locations, rate of advance, line and grade deviation, surface settlement or heave points and other pertinent information. Submit to the Owner’s Authorized Representative the following day for each shift worked.

1.7 DELIVERY, STORAGE, AND HANDLING:

A. Materials shall be unloaded and handled with equipment of adequate capacity, equipped with slings to protect the materials from damage. Storage of materials on the site shall be in a reasonably level well drained area. Individual pieces and bundles shall be stored with safe walking space between to allow full view for inspection purposes.

B. Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials on site in enclosures or under protective covering. Do not store materials directly on the ground. Keep the inside of pipes and valves free of dirt and debris.

C. Handling: Handle casing pipe and other accessories in a manner to ensure delivery to the excavation in sound undamaged condition. Take special care to avoid injury to coatings and linings on pipe; make satisfactory repairs if coatings or linings are damaged. Carry, do not drag, pipe to the excavation.

1.8 SITE CONDITIONS:

A. Microtunnel construction shall be performed so as not to interfere with, interrupt or endanger surface and activity thereon, and minimize subsidence of the surface, structures, and utilities above and in the vicinity of the tunnel. Support the ground continuously in a manner that will prevent loss of ground and keep the perimeters and face of the tunnel, passages and shafts stable. The Contractor shall be responsible for all settlement resulting from tunnel operations and shall repair and restore damaged

property to its condition prior to being disturbed to the satisfaction of the Owner's Authorized Representative at the expense of the Contractor.

B. Comply with applicable local ordinances, codes, statutes, rules and regulations, and regulations of the Federal Government, OSHA 29CFR 1926 and criteria of ANSI A10.16-81, "Safety Requirements for Construction of Tunnel Shafts and Caissons."

C. The Contractor shall conduct a geotechnical investigation of the area along the entire alignment of all microtunneling operations. Prior site soil investigation reports will be available to the Contractor. Interpretation of this material and making one's own investigation and determination of the work site soil conditions is the sole responsibility of the Contractor.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All materials proposed for microtunneling construction shall be as specified by the Contractor's Professional Engineer in charge of the system design and shall be approved by the Owner's Authorized Representative.

B. Casing Pipe:

1. Microtunneling pipe shall be the minimum shown on the Drawings and in accordance with this Section. Pipe shall be designed by the Contractor to be capable of withstanding both service and installation loads. Installation loads include, but are not limited to, jacking loads. Requirements below are for the use of a steel casing pipe, if the Contractor recommends use of a different casing pipe material they must submit suggestions to the Owner's Authorized Representative for review and approval.

2. Pipe: Steel pipe shall be in conformance with ASTM A 139, Grade B with a minimum yield strength of 35,000 psi and wall thickness of 0.75". Steel pipe shall be square cut with even lengths and shall comply with Articles 4.2, 4.3, and 4.4 of the API SPEC 5L. Liner pipe shall be new pipe. Provide the wall thickness as required in the design, meeting the requirements of Design Criteria above.

3. Roundness: The difference between the major and minor outside diameters and shall not exceed 1% of the nominal diameter or ½ inch, whichever is less. For pipe exceeding 48 inches in diameter, a maximum deviation of ½ inch shall be permitted provided the circumference tolerance is maintained within ¼ inch.

4. Circumference: The outside circumference at any point in a length of pipe shall be within 1.0% or 1/2-inch of the nominal circumference, whichever is less.

5. Straightness: The maximum allowable straightness deviation in any 10-foot length shall be 1/8-inch. For lengths over 10 feet, the maximum deviation of the entire length may be computed by the following formula, but not to exceed 3/8 inch in any 40 foot length:

   a. Maximum deviation in inches = (1/8) x (total length in feet)/10

6. The ends of the pipe shall be perpendicular to the longitudinal axis of the pipe within 1/16-inch per foot of diameter, with a maximum allowable deviation of ¼ inch,

measured with a square and straightedge across the end of the pipe. Remove all burrs from the ends of the pipe.

7. Casing pipe shall have all corrosion protection as required for casing pipe in SECTION 33 52 46 – Liquid Fuels Pipeline Coating Systems.
   a. Contractor shall submit a letter from the coating manufacturer stating that their product is suitable for use to control soil side corrosion on jacked pipe.
   b. Any damage to protective coating in the field shall be repaired per the manufacturer's recommendations and the proper cure time shall be adhered to prior to installing pipe.
8. Joints:
   a. Joints between pipes shall be protected in such a way as to distribute jacking load evenly with uniform stresses.
   b. Steel casing pipe joints shall be continuous, integral press fit Type 7 connections as manufactured by Permalok or other approved equals.
   c. Joints shall be watertight and constructed per the manufacturer's recommendation.
   d. Joints shall be protected from corrosion per SECTION 33 52 46 – Liquid Fuels Pipeline Coating Systems.
   e. Individual pipe sections shall be as long as possible to limit the number of joints.

C. Carrier Pipe Spacers and Insulators:
1. Casing insulators shall be custom pre-engineered design, high density polyethylene segmented or hot rolled steel insulators with rollers as manufactured by Advance Products & System Inc. (APS) or approved equal for use with pipe and casing sizes specified or indicated.
2. Spacers shall be manufactured to account for multiple carrier pipes to accommodate the size of carrier pipes and casing pipes indicated on the drawings.
3. Spacers shall be with equipped with high molded polymer runners.
4. Place at locations and spacing recommended by manufacturer but not more than 8 feet apart. Spacing shall not exceed 6 feet for casing pipes greater than 250 feet in length.
5. Casing insulators shall maintain slope of carrier pipes as indicated on the Drawings.
6. Leg lengths shall be sized to keep carrier pipe positioned within limits of end seal adjustment.
7. Size to fit outside diameter of carrier pipe and inside diameter of casing pipe.

D. End Caps:
1. End caps shall be welded on end caps which match the material of the casing pipe.

2. Provide the wall thickness as required in the design, meeting the requirements of Design Criteria of the casing pipe.

3. End caps shall have metal sleeves in the openings in which the carrier pipes pass through.

4. Seal gaps between the sleeve diameter and carrier pipe diameter with two link seals and one additional water proof sealant as the outer most seal as indicated on the Drawings.

5. End caps shall be protected from corrosion equal to that of which is required by the casing pipe and SECTION 33 52 46 – Liquid Fuels Pipeline Coating Systems.

E. Bentonite

1. Bentonite shall conform to API SPEC 13 A and have the capacity of mixing with water to form a stable and homogeneous suspension.

2. The bentonite/water mix shall be approximately 1:1 (by volume). No toxic or pollutant material may be used in the slurry mix.

F. Cement Grout

1. Cement shall be Type I Portland Cement conforming to the requirements of ASTM C150 and shall be delivered in bags or bulk.

2.2 EQUIPMENT:

1. All microtunneling equipment shall be remotely controlled. No persons shall be directly in tunneling shield. Contractor shall have sole responsibility for assessing subsurface conditions and selecting appropriate equipment and techniques to successfully complete work with minimal heave or surface settlement or risk of flowing from the cutting face during excavation. Tunneling equipment selected for the project shall be compatible with the geologic conditions present at the site. The tunneling equipment shall be capable of tunneling through mixed face conditions without exceeding the settlement tolerances specified.

2. The method and equipment used to install the pipe casing at each location shall be submitted by the Contractor.

3. The tunnel shield shall be full faced with the capability of supporting the face both during excavation and during shutdown. The shield shall have the ability to measure and continuously balance the earth/water pressure at the face by the use of slurry where needed.

4. All groundwater and surface water influences encountered during excavation of the tunnel must be controlled and balanced by the tunneling machine.

5. Slurry tunneling systems shall use a minimum volume of water in the slurry system.

6. The tunneling system shall be laser controlled and monitored by the operator at all times. All functions of the system shall be monitored and transmitted to the remote operations console. The minimum information available to the operator on the consoles shall include rate of advance, length of conduit installed, thrust force, deviation from line and grade, roll, inclination and valve positions. The laser shall

be mounted separately from the thrust block or other potentially moving or deforming points.

7. The excavation system shall be fully capable of excavating all material that it encounters.
8. The tunnel shield, if required, must be articulated and maneuvered by trunion mounted steering jacks or other equivalent method to enable accurate control of line and grade.
9. The tunneling system must be capable of maintaining line and grade to 2 inches plus or minus over the entire distance of the drive.
10. The tunneling shield, if required, must be capable of keeping drift and rotation or roll to a minimum. The tunneling shield must be capable of controlling rotation or roll by means of a bi-directional drive on the cutterhead, by the use of fins or flippers or by other equivalent method.
11. A lubrication system shall be provided that is capable of injecting a suitable lubricant to lower the friction developed on the exterior of the pipe during jacking if required due to swelling or squeezing soils or other conditions.
12. The overcut during installation shall not exceed 1.0-inch greater than the outside diameter of the pipe without approval of the Owner’s Authorized Representative. The annular space created by the overcut shall, if necessary, be filled with the bentonite and grout mixture that is suitable for the soil type encountered.
13. No gasoline powered equipment shall be permitted in jacking and receiving pits. Diesel, electrical and air powered equipment shall be evaluated by the Contractor's Engineer and, if determined to be acceptable, shall be subject to applicable local, state, and federal regulations. Special care shall be taken when setting the pipe guard rails in the starter shaft to ensure correctness of the alignment, grade, and stability.
14. The equipment shall have the capability of limiting the jacking force applied to the pipe/tunnel shield so as not to exceed the maximum compressive loads allowed for the pipe.
15. The main jacking equipment installed must have a capacity greater than the anticipated jacking load, as determined by the Contractor's Engineer.
16. Provide intermediate jacking ring(s) if materials encountered or distances between manholes or access pits require their use.
17. Provide a mechanical clamp capable of restraining the liner pipe against hydrostatic pressure while the jacks are retrieved.

PART 3 - EXECUTION

3.1 GENERAL:

A. The Contractor shall conduct a geotechnical investigation of the area along the entire alignment of all microtunneling operations. Prior site soil investigation reports and data obtained for design of the tunnel will be available to the Contractor. Interpretation of this material and making his/her own investigation and determination of the work site soil

conditions prior to bidding is the sole responsibility of the Contractor. Any rock and/or water encountered as stipulated in the soil investigation report and shall not entitle the Contractor to additional compensation.

B. Contractor shall have sole responsibility for the safety of all work activities including the tunnel, shafts, labor, materials, and equipment.

3.2 PREPARATION:

A. Access Shafts

1. Construction methods required to provide access shafts for microtunneling shall be subject to approval of the Owner's Authorized Representative.
2. Shafts shall be of a size commensurate with safe working practices and shall be installed at the location identified on drawings, unless otherwise approved by the Owner's Authorized Representative. With the approval of the Owner's Authorized Representative, the Contractor may relocate shafts to better suit the capabilities of the microtunneling method proposed.
3. Furnish all necessary equipment for dewatering, excavation, support system and all other associated work required to install and maintain the access shafts. Promptly dispose of, at the Contractor's expense, all unwanted excavated materials and water from dewatering at acceptable facilities in accordance with regulatory agencies having jurisdiction. Contractor shall conduct and control dewatering activities so as to not induce settlement.
4. Any contaminated materials unearthed during trenching operations shall be handled in accordance with specification section X-101.
5. Perform excavation, backfill and grading is accordance with Specification P-152 and to the requirements specified herein. The Contractor shall properly support all excavations and prevent movement of the soil, pavement, utilities or structures outside of the excavation.
6. Furnish, place, and maintain sheeting, bracing, and lining required to support the sides and floor of all access shafts and to provide adequate protection of the work, personnel, and the general public. Acceptable construction methods may include use of interlocked steel sheetpiling or precast circular concrete segments lowered in place during excavation. Design loads on the sides of the access shaft walls are dependent on the construction method and flexibility of the wall systems.
7. Construct a starter/jacking shaft or pit to accommodate the installation of pipe casings, slurry shield, and pipe jacking device. Install thrust block as required and consolidate the ground (grout) where the casings exit the shaft. Install a launch seal ring around the liner pipe to prevent water from entering the shaft.
8. Construct a receiver shaft or pit to accommodate the installation of pipe casings and slurry shield. Consolidate the ground (grout) where the casings enter the shaft.
9. When water is encountered, the Contractor shall furnish, install, and maintain equipment to keep the access shaft free of excess water. The Contractor shall also provide surface protection during the period of construction to ensure that

surface runoff does not enter driving shaft(s). Groundwater dewatering shall comply with the approved dewatering plan and shall not affect surrounding soils or structures beyond the tolerances.

10. Methods of dewatering shall be at the option and responsibility of the Contractor. Maintain close observation to detect settlement or displacement of surface facilities due to dewatering. Should settlement or displacement be detected, notify the Owner's Authorized Representative immediately and take such action as necessary to maintain safe conditions and prevent damage.
11. The initial opening through the jacking pit wall shall be performed in stages. If groundwater is encountered, Contractor shall take appropriate action to stop the flow of water prior to proceeding, including grouting, dewatering or other means. Launching seals shall be installed prior to launching to prevent intrusion of groundwater, loss of ground and loss of suitable pipe lubricant at jacking pits. The soil behind the launch seal shall be stabilized adequately to remain standing for the entire time required to perform the launch. Perform localized dewatering or grouting in advance of launch, if determined necessary to maintain stabilized soil behind the launch.
12. Provide jersey barriers around all work areas, access shaft and pit areas, and provide shaft cover(s) when the shaft area is not in use.
13. Design of the access shafts and pit supports shall take into account the loading from shield or pipe jacking where appropriate, as well as special provisions and reinforcement around the breakout location. The base of the pit shall be designed to withstand uplift forces from the full design head of water, unless approved dewatering or other ground modification methods are employed.
14. Where a thrust block is required to transfer jacking loads into the soil or rock, it shall be properly designed and constructed by the Contractor. The backstop shall be normal (square) with the proposed pipe alignment and shall be designed to withstand the maximum jacking pressure to be used with a factor of safety of at least 2.0. It shall also be designed to minimize excessive deflections in such a manner as to avoid disturbance of adjacent structures or utilities or excessive ground movement. If a concrete thrust block or treated soil or rock zone is utilized to transfer jacking loads into the soil or rock, the tunnel boring is not to be jacked until the concrete or other materials have attained the required strength.
15. Pit Backfill and Compaction: Upon completion of the pipe drive and approval of the installed pipeline by the Owner's Authorized Representative, remove all equipment, debris, and unacceptable materials from the pits and commence backfilling operation. Backfilling and compaction shall be complete in accordance with Specification P-152.
16. If tremie concrete sealing slabs are placed within the earth support system to prevent groundwater inflow when access shafts are dewatered, the sealing slabs shall be of sufficient thickness to provide a factor of safety equal to 1.2 against hydrostatic uplift in order to prevent bottom blowout when the excavation is completely dewatered.

17. The Contractor's Engineer shall properly design and Contractor shall construct thrust blocks perpendicular to the pipe alignment to support the maximum obtainable jacking pressure developed by the jacking system with a minimum factor of safety of 2.0 or greater.

3.3 MICROTUNNELING CONSTRUCTION:

A. Microtunneling:

1. The microtunneling boring machine shall be an unmanned mechanical type earth pressure counter-balanced bentonite slurry shield system. The machine shall be laser guided and monitored continuously, with a closed circuit television system. The machine shall be capable of fully supporting the face both during excavation and during shutdown and shall have the capability, of positively measuring the earth pressure at the face. Excavation face pressure shall be maintained at all times between the measured active earth pressure and 50 percent of the computed passive earth pressure. Fluid pressure applied at the face to stabilize the excavation shall be maintained at a level slightly in excess of normal hydrostatic pressure and shall be monitored continuously. Boring machine shall be steerable and capable of controlling the advance of the heading to maintain line and grade. The machine shall be capable of handling and removing materials of high water content from the machine head.

2. Each pipe casing section shall be jacked forward as the excavation progresses in such a way to provide complete and adequate, ground support at all times. Control advance rate and volume of material excavated with front face opening or fluid pressure adjustments to eliminate subsidence, settlement and heave. All work shall be done so as not to disturb roadways, adjacent structures, landscaped areas, or utilities. Any damage shall be immediately repaired to the satisfaction of the agency or utility having jurisdiction, at the Contractor’s expense.

3. Overcut shall not exceed 1.0 inch greater than the outside diameter of the pipe.

4. Contaminated soils are not anticipated, however if encountered, would require slurry and water to be disposed of in accordance with specification section X-101 and local, state and federal regulations. Hydrocarbon contaminated soils will not be permitted for use as backfill, and the excavation of contaminated soil should be minimized if possible.

5. A jacking frame shall be provided for developing a uniform distribution of jacking forces around the periphery of the pipe. A plywood spacer shall be placed on the outer shoulder of the pipe casing joint. The thrust reaction backstop shall be properly designed and constructed. The backstop shall be normal (square) with the proposed pipe casing alignment and shall be designed to support the maximum obtainable jacking pressure with a safety factor at least 2.0.

6. The jacking system shall be capable of continuously monitoring the jacking pressure and rate of advancement. Prior to starting jacking operations, survey the location and orientation of the pipe guide rails to ensure they are on the proper line and grade.

7. Set the pipe to be jacked on properly braced and supported pipe guide rails. Maximum compressive stresses applied to the pipe at any time shall not exceed

35% of the design compressive strength of the pipe. Pipes shall be jacked into place without damaging the pipe or pipe joints. In the event a section of pipe is damaged during the jacking operation, the pipe shall be jacked through to the end and removed.

8. The axial forces from the thrust jacks shall be distributed to the pipe uniformly through cushion material to prevent damage to the ends of the pipe.
9. As a minimum, the thrust force, rate of advance, distance along the drive and deviation from line and grade shall be monitored and recorded for each pipe installed.
10. The volume of slurry shall be measured for each liner pipe section and compared with the volume of annular overcut. Injected bentonite and grout mixture volumes should be at least the theoretical annular void due to the shield overcut, shield taper and other dimensions that contribute to the annular void formation.
11. The slurry shall be mixed with a colloidal mixer and allowed to hydrate a minimum of 2 hours before pumping.
12. Bentonite and grout mixture (driller's mud) shall be applied to the external surface of the pipe to reduce skin friction. The bentonite and grout mixture used to lubricate the exterior of the liner pipe shall be injected through grout fittings inserted to the liner pipe and located immediately behind the shield overcut in the crown and below the springline. There shall be at least 3 grout fittings per liner pipe section. Equipment used to mix and pump the bentonite and grout slurry shall be equipped with a pressure gage located at the grout fitting.
13. The Contractor shall use lines and grades established from benchmarks to establish the exact location of the pipe using a laser guidance system on the tunneling machine.
14. Steel pipe casing joints shall be continuous integral press fit connectors as manufactured by Permalok or other approved equals.
15. Monitor line and grade continuously during pipe jacking operations. Record deviation with respect to design line and grade at least once per pipe installed and submit records to the Owner’s Authorized Representative.
16. Contractor shall constantly monitor the ground, pavement, and subsurface above the microtunneling path during operations for evidence of subsidence. Ground surface settlement surveys shall reference bench marks and indices sufficiently remote as not to be affected by the tunnel operations. If subsidence exceeds 0.5 inches at any time at any location above the microtunneling path based upon continuous elevation checks by the Contractor’s surveyor, the Contractor shall immediately cease microtunneling operations, notify the Owner’s Authorized Representative, identify the source of subsidence, and take corrective action. The Contractor shall provide means to correct settlement and ensure that no additional settlement will occur prior to continuing operations. Microtunneling operations shall not recommence without the approval of the Owner’s Authorized Representative. Any damaged caused to existing pavement and structures due to settlement shall be repaired at the Contractor’s expense.

17. When excavation is off line or grade, make the necessary corrections at a rate of not more than 1-inch per 25 feet to return to the plan line and grade.

18. If the pipe installation exceeds the specified tolerances, correct the installation, including, if necessary, redesign of the pipeline or structures. All corrective work shall be performed at the expense of the Contractor and is subject to the approval of the Owner's Authorized Representative.

19. Contractor shall be responsible to limit not only the overall tolerances, but also limit the extent of irregular kinks or snaking of pipe, so as to minimize friction losses and joint edge stresses.

20. After completion of the jacking operation the lubricant material shall be displaced from between the pipe casing exterior and the surrounding ground by a water/cement grout. Pressure and the amount of grout shall be controlled to avoid pipe damage and displacement of the pipe and soil beyond the tolerances specified. Grouting shall be accomplished promptly after pipe installation has been completed to prevent any surface settlement due to movement of soil material into the void space or loosened zone around the pipe casing. Grout shall be installed in the lower quadrant ports first, displacing toward the crown. The top crown port shall be grouted last in each progressive section of pipe.

B. Tunnel Tools and Equipment:

1. Power machinery and tools, within the tunnel shall be operated by electricity, compressed air, or diesel with approved scrubber or other approved power. Electrical tools and equipment shall be grounded in accordance with the latest requirements of the National Electrical Code.

2. Provide temporary electric lights to properly and safely illuminate all parts of the tunnel construction area including special illumination at the working face. Lighting circuits shall be thoroughly insulated and separated from power circuits, and lights shall be enclosed in wire cages. Secure electrical permits required for successful completion of this work.

C. Ventilation and Air Quality:

1. Prior to tunnel entry, provide, operate and maintain for duration of tunnel project a ventilation system to meet safety and OSHA requirements.

2. The capacity of the ventilation equipment is solely the Contractor's responsibility, and shall comply with local, state, and federal regulations. The Contractor shall provide and maintain an adequate ventilation system.

D. Tunnel Operations:

2. Control the tunnel face at all times.

3. Whenever the tunnel operation is suspended, support the tunnel face by positive means and keep dewatering system operating. Have qualified personnel periodically check conditions that might threaten the stability of the tunnel.

3.4 CONTRACTOR QUALITY CONTROL

A. General:

1. The following describes the minimum inspection and testing required in the Contractor's quality Control Program for the work of this section. The Contractor Quality Control Program shall include, but not be limited to, the elements included herein. These elements are provided only as a minimum starting point for the Contractor to use to generate the complete Contractor's Quality Control Program.
2. The Contractor shall develop a detailed Quality Control Program for the work of this section. The Contractor Quality Control Program shall include, but not be limited to, the elements addressed by this specification. The Contractor's Quality Control Program shall be developed to address specific aspects of the tunneling method selected including but not limited to:
3. Monitoring of tunnel grade and alignment.
4. Inspection of casing pipe welds.
5. Inspection of casing pipe sections, insulators, and end seals.
6. Settlement monitoring.
7. Field survey methods.
8. Control of ground water and surface water.
9. Design and construction of access shafts.
10. Monitoring of excavation support measures.
11. Monitoring of existing adjacent structures and utilities.
12. Operation and maintenance of tunneling equipment.
13. Implementation of remedial measures if necessary.

3.5 FIELD QUALITY CONTROL:

A. For casing pipe inside dimensions of the ring measured along the diameter at any location shall not vary more than three percent of the casing plate diameter. Construct tunnel to the line and grade shown on the Drawings. Maintain a positive grade toward the outlet end with no ponding pocket.

END OF SECTION 33 05 22

SECTION 33 05 23 – TRENCHLESS UTILITY INSTALLATION

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 specified in this section consists of furnishing and installing underground utilities using the horizontal directional drilling (HDD) method of installation, also commonly referred to as directional boring or guided horizontal boring. This work shall include all services, equipment, materials, and labor for the complete and proper installation testing, restoration of underground utilities and environmental protection and restoration.

1.3 QUALITY ASSURANCE

A. Design Requirements

1. Horizontal alignment shall be as shown on the Drawings. The pipe shall have a minimum 36-inch cover. The maximum depth shall be determined based on 18-inch minimum clearance from the existing or proposed utilities to be crossed. Compound curvatures may be used but shall not exceed the maximum deflections as set forth by the pipe manufacturer or AWWA C-906/C-900 Standards whichever is stricter.

2. Entry angle shall be 12° - 14° ideal (not to exceed 15°). Exit angle shall be 6° - 12° to facilitate “pull-back.”

3. Entry and exit angles are defined as angles from the horizontal.

B. Qualifications: Directional Drilling Contractor shall have a minimum of four years experience with similar construction including pipelines of the same or larger diameter and the same or greater lengths. The Contractor shall also have successfully completed a minimum of five (5) similar projects of the same or larger diameter and of equal or greater lengths.

C. Reference: All work specified herein shall conform to or exceed the applicable requirements of ASTM F 1962 (latest edition). This includes planning, design, and execution of the directional drill.

1.4 SUBMITTALS

A. Work Plan: Prior to beginning work, the Contractor must submit to the Engineer a work plan detailing the procedure and schedule to be used to execute the project. The work plan should include a description of all equipment to be used, down-hole tools, a list and resumes of key personnel and their qualifications and experience, list of subcontractors, a schedule work activity, a safety plan, traffic control plan, an environmental protection plan and

contingency plans for possible problems. Work plan should be comprehensive, realistic and based on actual working conditions for this particular project. Plan should document the thoughtful planning required to successfully complete the project.

B. Pre-construction conference: Contractor will prepare and attend a pre-construction conference with the utility provider/owner, engineer, and contractor's authorized representatives to discuss and coordinate work schedule, requirements, and effort.

C. Equipment: Contractor will submit specifications on directional drilling equipment to be used to ensure that the equipment will be adequate to complete the project. Equipment shall include but not be limited to: drilling rig, mud system, mud motors (if applicable), down-hole tools, guidance system, rig safety systems. Calibration records for guidance equipment shall be included. Specifications for any drilling fluid additives that Contractor intends to use or might use will be submitted.

D. Material: Specifications on material to be used shall be submitted to the Engineer. Material shall include the pipe, fittings and any other item which is to be an installed component of the project. All pipe and appurtenances of similar type and material shall be furnished by a single manufacturer. All pipe and appurtenances of similar type and material shall be furnished by a single manufacturer.

E. Bore Path Layout and Design: The Contractor shall submit a proposed bore path layout in both plan and profile. The proposed path should conform to the drilling equipment and pipe material constraints. The Contractor shall also submit calculations confirming the stresses imposed during installation and in-service (after installation) are within the allowable limits (i.e., allowable pullback force, deflection and buckling) of the selected pipe materials. Calculations shall utilize the equations presented in ASTM F 1962.

PART 2 - EQUIPMENT

2.1 GENERAL

A. The directional drilling equipment shall consist of a directional drilling rig of sufficient capacity to perform the bore and pull-back the pipe, a drilling fluid mixing, delivery and recovery system of sufficient capacity to successfully complete the crossing, a drilling fluid recycling system to remove solids from the drilling fluid so that the fluid can be reused, a magnetic guidance system to accurately guide boring operations, a vacuum truck of sufficient capacity to handle the drilling fluid volume, trained and competent personnel to operate the system. All equipment shall be in good, safe operating condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working order for the duration of this project.

2.2 DRILLING SYSTEM

A. The directional drilling machine shall consist of a hydraulically powered system to rotate, push and pull hollow drill pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill (bore) head. The machine shall be anchored to the ground to withstand the pulling, pushing and rotating pressure required to complete the crossing. The hydraulic power system shall be self-contained with sufficient pressure and volume to power drilling operations. Hydraulic system shall be free of leaks. Rig shall have

a system to monitor and record maximum pull-back pressure during pull-back operations. The rig shall be grounded during drilling and pull-back operations. There shall be a system to detect electrical current from the drilling string and an audible alarm, which automatically sounds when an electrical current is detected.

2.3 PIPE

A. Pipe shall be HDPE and have ductile iron pipe outside diameter(s) and be in accordance with AWWA C906. The dimension ratio shall be verified by the Contractor based on the anticipated pullback force and external loads required for the directional drilling. The minimum working pressure rating of the pipe supplied shall be minimum 200 psi. Piping shall be as specified in section 331100. Water piping will be blue or have impregnated blue stripes the entire length of the pipe.

B. Pipes shall be marked in accordance with AWWA requirements.

2.4 DRILLING FLUIDS

A. Drilling fluids shall consist of a mixture of potable water and gel-forming colloidal material such as bentonite, or a polymersurfactant mixture producing a slurry of custard-like consistency.

B. Containment and proper disposal of the drilling fluid shall be the responsibility of the Contractor.

PART 3 - EXECUTION

3.1 PERSONNEL REQUIREMENTS

A. Responsible representatives of the Contractor shall be present at all times during the actual drilling operations. A responsible representative as specified herein is defined as a person experienced in the type of work being performed and who has the authority to represent the Contractor in a routine decision making capacity concerning the manner and method of carrying out the work specified herein.

B. The Contractor shall have sufficient number of competent workers on the project at all times to ensure the utility placement is made in a timely, satisfactory manner. Adequate personnel for carrying out all phases of the actual drilling operation (where applicable: tunneling system operators, operator for removing spoil material, and laborers as necessary for various related tasks) must be on the job site at the beginning of work. A competent and experienced supervisor representing the CONTRACTOR that is thoroughly familiar with the equipment and type of work to be performed, must be in direct charge and control of the operation at all times. In all cases, the supervisor must be continually present at the project site during the actual drilling operation.

3.2 COORDINATION OF THE WORK

A. The Contractor shall notify the Owner and Engineer at least 24 hours in advance of starting work. In addition, the actual crossing operation shall not begin until the Engineer or his representative is present at the project site and agrees that proper preparations for the crossing have been made. The Engineer’s approval for beginning the crossing shall in no

way relieve the Contractor from the ultimate responsibility for the satisfactory completion of the Work.

B. The Contractor and the Engineer shall select a mutually convenient time for crossing operation to begin in order to avoid schedule conflicts.

3.3 MAINTENANCE OF TRAFFIC

A. Erection or installation of appropriate safety and warning devices in accordance with the Florida Department of Transportation (FDOT) Manual on Traffic Control and Safe Practices shall be completed prior to beginning work.

3.4 INSTALLATION

A. Erosion and sedimentation control measures and on-site containers shall be installed to prevent drilling mud from spilling out of entry and/or exit pits. Drilling mud will be disposed of off-site in accordance with local, state and federal requirements and/or permit conditions.

1. No other chemicals or polymer surfactant shall be used in the drilling fluid without written consent of the Engineer, and after a determination is made that the chemicals to be added are not harmful or corrosive to the facility and are environmentally safe.

B. Pilot Hole: Pilot hole shall be drilled on bore path with no deviations greater than 2 percent of depth over a length of 100 feet. In the event that pilot does deviate from bore path more than 2 percent of depth in 100 feet, Contractor will notify Engineer and Engineer may require Contractor to pull-back and re-drill from the location along bore path before the deviation.

C. Reaming: Upon successful completion of pilot hole, Contractor will ream bore hole to a minimum of 40 percent greater than outside diameter of pipe using the appropriate tools. Contractor will not attempt to ream at one time more than the drilling equipment and mud system are designed to safely handle. The Contractor shall take all precautions required to avoid inadvertent mud returns (frac outs).

D. Pull-Back: After successfully reaming bore hole to the required diameter, Contractor will put the pipe through the bore hole. In front of the pipe will be a swivel and barrel reamer to compact bore hole walls. Once pull-back operations have commenced, operations must continue without interruption until pipe is completely pulled into bore hole. During pull-back operations, Contractor will not apply more than the maximum safe pipe pull pressure at any time. Contractor shall protect the pipe from damage or gouging at all times and shall at no time overstress the pipe during pull-back or any other operation.

E. As-built variance from the designed bore path shall not exceed 1 foot in the vertical plane and 2 feet in the horizontal plane. Contractor shall submit any proposed deviations from the design bore path with shop drawings. Contractor shall use true tracker tracking system or equal in order to achieve as-built variance.

F. The pipe entry area shall be graded to provide support for the pipe to allow free movement into the borehole. The pipe shall be guided in the borehole to avoid deformation of, or damage to, the pipe.

G. If unexpected subsurface conditions are encountered during the bore, the procedure shall be stopped. The installation shall not continue until the Owner and Engineer have been consulted.

H. The pipe shall be pulled back through the bore hole using the wet insertion construction technique. The pipe may be installed full of water.

I. The pipe shall be installed in a manner that does not cause upheaval, settlement, cracking, movement or distortion of surface features.

3.5 HYDROSTATIC TESTING OF HDPE PIPING

A. Pressure Testing and Leakage Testing

1. The Contractor shall provide all necessary equipment and instrumentation required for flushing and testing of the piping systems. If requested by the Owner, the Contractor shall furnish to the Owner certified test data for the pressure gauges and recorders used on hydrostatic equipment. Testing shall be conducted in the presence of and to the satisfaction of the Owner and EOR as a condition precedent to the approval and acceptance of the system. Not less than 3 days notice shall be given prior to start of such tests, and such testing shall not be scheduled until preliminary testing by the Contractor has indicated that the test section is ready for testing. The schedule and procedures for testing shall be determined by the Contractor and reviewed with the Owner prior to testing.

2. Before conducting the test, the Contractor shall backfill all pipe and reaction blocking unless the Owner directs certain joints or connections to be left uncovered. When reaction blocking is provided, the pressure test shall not be made until adequate curing time for the blocking has been allowed.

3. The testing of the HDPE line will be done separately from the DIP or PVC line.

4. All testing will be done with potable water.

5. The test pressure will be 150 psi.

6. The pipe is to be filled with water and all air is to be expelled from the pipe prior to the test. Blowoff valves are to be provided at all high points to expel air.

7. Hydrostatic testing will be done at 150 psig at the highest point. Apply and maintain the test pressure by means of a positive displacement hydraulic force pump.

8. The maximum duration for the pressure test, including initial and final phase of the test, shall not exceed eight (8) hours. If the test is not completed due to leakage, equipment failure, etc., depressurize the test section, and then allow it to “relax” for at least eight (8) hours and other such time as recommended by the manufacturer before bringing the test section up to test pressure again.

B. Initial Phase

1. All air must be removed from the test section. All flanged or mechanical joint valves and fittings shall be left exposed for visual leak inspection for visual leak inspection.

2. The pressure within the test section should be raised to approximately 160 psi and then allowed to be idle (no additional make-up water/pressure to be injected), for approximately 3 hours.

3. No additional make-up water/pressure shall be applied to the test section during this 3-hour stabilization period unless the line pressure drops below 140 psi. In this case, make-up water/pressure shall only be applied to the test section to maintain a minimum of 140 psi (during the 3-hour stabilization period).

C. Final Phase

1. The final phase of the pressure test shall involve applying make-up water/pressure to achieve an “initial test pressure” of 150 psi.

2. The test section is then allowed to be idle (no make-up water/pressure is added) for a period of 2 hours. After this 2-hour period, make-up water/pressure is applied and measured to re-establish the “initial test pressure”.

3. The quantity of water utilized to re-pump the line shall be measured and compared to the allowable quantities as determined by the table below. If the actual make-up water quantity is equal or less than the allowable amount, the pressure test passes. If the actual make-up water quantities are greater than the allowable amount, the pressure test fails

Allowable Make-up Water	
Nominal Pipe Size (inches)	**Make-up Water Allowance (gallons/linear feet of pipe) for a 2-hour test**
6	0.0030
8	0.0050
10	0.0065
12	0.0115
14	0.0140
16	0.0165
18	0.0215
20	0.0275
22	0.0350
24	0.0440

4. In the event a section fails to pass the tests, the Contractor shall do everything necessary to locate, uncover (even to the extent of uncovering the entire section), and replace the defective pipe, valve, fitting or joint. Visible leaks shall be corrected regardless of total leakage. Lines which fail to meet these tests shall be retested as necessary until test requirements are complied with. All testing shall be performed at the Contractor's expense.

D. Repetition of Test

If the actual leakage exceeds the allowable, locate and correct the faulty work and repeat the test. Restore the work and all damage resulting from the leak and its repair. Eliminate visible leakage.

E. Test Facility Removal

After a satisfactory test, remove the testing fluid, other test facilities, and restore the pipe coatings.

3.6 DISINFECTION

A. After water lines are tested hydrostatically, flushed and immediately prior to being accepted for Substantial Completion, disinfect pipes in accordance with AWWA C651 except as modified herein. Disinfection shall be done using calcium hypochlorite solution, liquid chlorine, or chlorine solution of strength to achieve not less than 50 parts per million of free chlorine in the pipeline. Fill the line with water and maintain line under pressure of not less than ten (10) pounds per square inch for not less than 24 hours. During this period when the line is under pressure, open and close all valves within the section being tested, as required to affect disinfection of valve working parts. Following this period, check chlorine residual and flush the line clean for biological testing.

B. Any remaining superchlorinated water shall be neutralized using sodium thiosulfate or other acceptable neutralizing agent before allowing controlled flushing. Discharges shall be controlled in accordance with the permitted stormwater pollution prevention plan requirements with turbidity barriers, monitoring and other acceptable measures. After flushing bacteriological sampling will then be performed. The Contractor will be required to submit a complete testing, disinfection and flushing plan for review and approval prior to the performance of any of these activities.

C. Repeat the disinfection process if biological testing shows unsatisfactory samples. All procedures shall be in conformance with the General Requirements. No cross-connection between the water mains and any pipe which has not been disinfected, shall be permitted. The Contractor shall furnish and install blind flanges or shall otherwise plug outlets for disinfection purposes.

END OF SECTION 33 05 23

SECTION 33 05 24 – BORING AND JACKING

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. Scope of Work: Furnish all material, equipment, transportation, tools and labor to install casing pipe by boring and jacking method, carrier pipe within casing, casing end seals, and all related excavation, backfill, testing and other work for a complete job.

1.3 QUALITY ASSURANCE

A. Jurisdiction: For casing pipe crossing under roadways or other installations not within the jurisdiction of the Owner, the Contractor shall comply with regulations of said authority. State highway casing installations shall be as specified in the Florida Department of Transportation, "Utility Accommodation Guide," shall be applicable.

B. Existing utilities location shall be verified by Contractor prior to constructing drilling and receiving pits.

C. Qualifications: Boring and Jacking Contractor shall have a minimum of four years experience with similar construction including pipelines of the same or larger diameter, the same or greater lengths, and with crossing similar roadways. The Contractor shall also have successfully completed a minimum of five (5) similar projects of the same or larger diameter and of equal or greater lengths.

1.4 SUBMITTALS

A. Work Plan: Prior to beginning work, the Contractor must submit to the Engineer a work plan detailing the procedure and schedule to be used to execute the project. The work plan should include a description of all equipment to be used, down-hole tools, a list and resumes of key personnel and their qualifications and experience, list of subcontractors, a schedule work activity, a safety plan, traffic control plan, an environmental protection plan and contingency plans for possible problems. Work plan should be comprehensive, realistic and based on actual working conditions for this particular project. Plan should document the thoughtful planning required to successfully complete the project.

B. Pre-construction conference: Contractor will prepare and attend a pre-construction conference with the utility provider/owner, engineer, and contractor’s authorized representatives to discuss and coordinate work schedule, requirements, and effort.

C. Certification: Supplier of casing shall certify conformance to these specifications.

D. Laying schedule including length, diameter and thickness of casing for each crossing.

E. Casing spacers and end seals.

F. Dewatering Plan.

G. Similar Project Experience by Subcontractor

PART 2 - PRODUCTS

2.1 MATERIALS

A. Casing: New prime steel pipe conforming to ASTM A-139, Grade B. Pipe shall be seamless or have not more than one (1) longitudinal weld. Minimum casing pipe size and wall thickness shall be as indicated in the following table where D.O.T. requirements are for road crossings:

Carrier Pipe		Casing Pipe	
Nominal Size (Inches)	Gland O.D. (Inches)	Diameter (Inches)	Outside Wall Thickness (Inches) D.O.T.
8"	13.63	20"	.250
10"	15.81	24"	.250
12"	18.06	30"	.312
16"	22.94	30"	.312
20"	27.08	36"	.375
24"	31.58	42"	.500
30"	39.12	48"	.500
36"	46.00	54"	.500
42"	53.12	60"	.562

B. Carrier Pipe: Carrier pipe installed within casing shall be ductile iron pipe, unless otherwise noted on the plans, equipped with mechanical restrained joint connections. Minimum wall thickness for ductile iron pipe is Class 200. PVC pipe in casing shall have a mechanical bell restraint harness where rods are double nutted to preclude overbelling the joint during pushing carrier pipe in casing.

C. Carrier Pipe Spacers: Carrier pipes inside of steel casing pipe shall be supported by casing spacers at no more than 10 feet between spacers. Each spacer shall be 12 inches wide and manufactured of minimum 14 gauge Type 304 stainless steel or 14 gauge steel with fusion bonded PVC coating. Spacers shall be lined with a 90 mil PVC liner. All nuts and bolts shall be corrosion resistant and compatible with the respective steel band. Each spacer shall have a minimum of 4 runner supports manufactured of a high molecular weight polymer plastic. The runner supports shall be of adequate height to position the carrier pipe in the center of casing with a minimum top clearance of 1/2-inch. All casing spacers larger than 36 inch diameter (carrier pipe) shall be factory designed, taking in consideration the weight of the carrier pipe filled with water. All calculations and drawings shall be submitted to the Engineer for review. Casing spacers shall be manufactured by Advanced Products and Systems, CCI Pipeline Systems, Pipeline Seal and Insulator or approved equal.

D. Casing End Seals: Casing end seals shall be used to completely close both openings on either side of the casing. These end seals shall be pull on (seamless) or wrap around with stainless steel straps for securing to the carrier pipe and the casing. End seals shall be constructed of specially compounded synthetic rubber a minimum thickness of one-eighth of an inch.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Boring and Jacking: The boring and jacking operations shall be done simultaneously, with continuous installation, until the casing pipe is in final position. Correct line and grade shall be carefully maintained. Add-on sections of casing pipe shall be full-ring welded to the preceding length, developing watertight total pipe strength joints. The casing installation shall produce no upheaval, settlement, cracking, movement or distortion of the existing roadbed or other facilities. Following placement of the carrier pipe within the steel casing, end seals shall be installed at each open end. Said seals shall be suitable for restraining the external earth load. The casing shall have a minimum 48 inches depth of cover between the top of the casing and the roadway surface, and a minimum 66 inches depth of cover between top of the casing and base of rail.

B. Auger: Casing pipe holes shall be mechanically bored through the soil by a cutting head on a continuous auger mounted inside the pipe. The auger shall extend a minimum distance beyond the end of the casing pipe to preclude formation of voids outside of the pipe shell.

C. Casing Protection/Damage: The casing pipe shall be adequately protected to prevent crushing or other damage under jacking pressures. Backstops shall be provided for adequately distributing the jack thrust without causing deformation of the soil or other damage. Should the casing pipe be damaged, such damaged portion, if not abandoned in place, shall be suitably plugged, and an alternate installation made, after approval is obtained from the Owner.

D. Excavation: Required boring and jacking pits or shafts shall be excavated and maintained to minimum dimension. Said excavations shall be adequately barricaded, sheeted, braced and dewatered, as required, in accordance with the applicable portions of these Specifications.

E. Roadway Crossing:

1. The utility main under the indicated roadways shall be installed in a casing to be bored and jacked under the pavement. The steel casing and jacking procedures shall conform to the requirements of the Florida Department of Transportation as outlined in Utility Accommodation Guide Procedure No. 592-400 and any supplements thereto. All work and materials shall be subject to inspection by Owner. The Owner's property and surface conditions shall be restored to their original condition in keeping with the Department of Transportation's or City of Orlando’s Specifications and Standards, as applicable.

2. The Contractor shall maintain traffic on the roadway and shall keep all workmen and equipment clear of the pavement during the work. All safety regulations of the Department of Transportation shall be complied with.

3. The top of the casing shall maintain a minimum 48 inch clearance under the roadway surface in FDOT rights-of-way (36 inches of clearance under County roadway surfaces) and 36 inch cover in all other areas of the right-of-way. Casing spacers for sliding the carrier pipe through the casing shall be permanently banded to the carrier pipe. After the carrier pipe has been tested for leakage the ends shall be blocked with casing end seals.

END OF SECTION 33 05 24

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).

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. 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. 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.

C. 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.

D. 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.

E. 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.

F. 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.

G. No glued joints shall be allowed. Mechanical restrainers are the only acceptable method of restraint.

H. 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/A2l/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.

MAKE	**SIZES**	**REQUIREMENT MET**
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 (NaOCI), 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 disinfect ion. 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 – POLYVINLY 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 (de-
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 (de-
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. Particular 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	¾"	3 ½"
6"	6	¾"	3 ½"
8"	6	¾"	3 ½"

10”	8	¾”	3 ½”
12”	8	¾”	3 ½”
16”	12	¾”	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 (NaOCI), 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 replace 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 331300.

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 pres-

sure 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 19 – PUBLIC UTILITY WASTEWATER PUMPING STATIONS

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 to construct and install a complete, automatic, underground pumping station with all factory-built equipment installed in a reinforced concrete pump wet well and a reinforced concrete valve chamber complete with all pipe, valves, and fittings.

B. Principle items of equipment included in the pump station: wet well, influent piping (one length), effluent piping (to the wye), valves, valve boxes and covers, pumps and motors, hatches, control panel, telemetry system, electrical service and wiring.

1.3 APPLICABILITY

A. Unless stated in the Drawings, all pump stations that are to be constructed in accordance to City of Orlando requirements.

1.4 REFERENCES

A. City of Orlando Engineering Standards Manual (latest revision). 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: Wet well, pump control panel and panel wiring diagram.

B. Product Data: Pump data and pump curves, pipe materials, pipe fittings, valves, and accessories.

1.6 QUALITY ASSURANCE

A. Factory Tests: Check each pump for alignment, clearance, and vibration. Eliminate misalignments, improper clearances, and excess vibration.

B. Field Tests: Perform field tests specified in this section.

PART 2 - PRODUCTS

2.1 STRUCTURES

A. Reinforced concrete pipe installed vertically for use as a pumping station, shall have steel reinforcement equal to or exceeding ASTM designation C478, latest revision, and shall conform or exceed the wall thickness of Table 2, Wall B, ASTM designation C-76, latest revision.

B. Concrete shall be 4000 PSI/28 day and shall be made using Type II Portland Cement.

C. Valve vaults may be precast or poured in place concrete.

D. Top and bottom slabs to be per the plan drawings for both the wet well and valve vault.

E. Wall reinforcement shall include No. 4 rebar hoop around each pipe opening.

F. All structures to be wet cast. Dry casting or low slump concrete will not be allowed.

G. All bases will have proper lifting hooks in the bottom slabs (min. of 3) and there will be no penetrating lifting holes on any structures.

H. No holes allowed within 6 inches of any joint.

2.2 DUCTILE IRON PIPE (DIP) AND FITTINGS

A. Ductile iron pipe (DIP) and fittings shall be in accordance with Section 333400.

2.3 PUMPS AND MOTORS

A. The pumps shall be capable of handling raw unscreened sewage. The design shall be such that the pumps will be automatically connected to discharge piping when lowered in place. The pumps shall be easily removable for inspection or service, requiring no bolts, nuts, or other fastenings to be removed for this purpose.

B. Each pump shall be fitted with a lifting lug, bracket, etc. of adequate strength and length to permit raising the pump for inspection and removal.

C. Each pump shall be capable of delivering the GPM and TDH as shown on the drawings without motor overloading. Head-capacity (performance) curves shall verify the pumps are operating at peak efficiency for application.

D. Pumps serving the APM/ITF shall be capable of passing a 3-inch diameter solid.

E. Motors that are 10 HP or larger shall be 480 volt, 60 Hz, 3 Phase. Motors less than 10 HP may be 120/240 volt, 60 Hz, 1 phase.

F. Pumps shall be Flygt, Fairbanks Morse, Hydromatic (less than 50 HP) or ABS (less than 50 HP), with no substitutions allowed.

2.4 DISCHARGE ELBOW

A. Discharge elbows shall be compatible with Flygt standard connection.

2.5 GUIDERAILS, UPPER HOLDERS, CABLE HOLDERS, ANCHOR BOLTS, AND LIFTING CHAINS

A. Guiderails, upper holders, cable holders, anchor bolts, and lifting chains shall be stainless steel. Guiderails shall have 2-inch minimum diameters.

2.6 ACCESS FRAMES AND COVERS

A. Access frames and covers shall be structural aluminum with 316 Stainless Steel hardware, sized to provide access clearance as required by the pump manufacturer and as required to adequately service and/or remove check valves from the check valve vault. Cover shall have lifting handles safety latches and locking hasp. Frames and covers shall be traffic bearing type exceeding AASHTO H-20 specifications. Flygt Safe-Hatch design or approved equal shall be installed on a wet well access cover.

2.7 PLUG VALVES

A. Plug valves shall be in accordance with Section 333400.

2.8 CHECK VALVES

A. Check valves shall be in accordance with Section 333400.

2.9 AIR RELEASE VALVES

A. Air release valves shall be in accordance with Section 333400.

2.10 CONTROL EQUIPMENT

A. Enclosure shall be 316 stainless steel, minimum 14 gauge, weatherproof, NEMA-3R with dead front panel, separate removable inside panel and handle and extra large padlock provision, drip shield, powder coated white or sun shields.

B. Main disconnect shall have two manual interlocked Schneider Electric Square D or Siemens I-T-E circuit breakers.

C. Telemetry shall be Motorola, radio controlled, to match City of Orlando existing equipment and include NEMA-4X stainless steel enclosure w/locking handle powder coated white antenna and mounting pole or tower. Antenna height shall be 20 feet from finished grade of station.

D. Controls shall be 120 volts, 60 HZ.

E. Starters shall be manufactured by Allen Bradley.

F. Bubbler Level Control shall be Siemens HydroRanger 200 Part No. 7ML5034-1 AD01 (4-20mA) with Echomax XPS-15 Transducer (6 degree) Part No. 7ML 1118-0BA30 5m cable, Part No. 7ML 1118-0CA30 10m cable, or Part No. 7ML 1118-0EA30 30m cable, Hand-Held Programmer Part No. 7ML 1830-2AK. The transducer shall be mounted using either a FMS-210 Wall-Mount (5-10" Part No. 7Ml1830-1BL or a FMS-220 Extended Wall-Mount (13-39"High-level Sensor shall be normally open and have a mercury-free Anchor scientific Eco-Float or Siemens Water Technologies USF Model 9G-EF direct-acting float switch for telemetry alarm.

G. Local high level alarm shall have a 115 Volt AC light in weatherproof bracket fixture for 100 watt lamp with red enclosing vapor tight globe with flasher and bell or buzzer. Local high level alarm shall be activated by a high set point programmed into the level control.

H. Relays shall be manufactured by Diversified Electronics, Inc., Potter Brumfield or approved equal. Relays shall have an 8-pin plug-in type base.

I. Elapsed Time Meters shall be manufactured by General Electric or approved equal.

J. HOA Switches shall be manufactured by Allen Bradley, Bulletin 800t-J2B.

K. Lightning Arrester shall be manufactured by General Electric and 3 phase.

L. Phase Voltage Monitor Relay shall have Phase loss, phase reversal and low voltage sensor and relay to alarm system and shall be manufactured by Diversified Electronics or approved equal.

M. Pump run indicator lights shall be Allen Bradley 800T-Q 1 0R.

N. Emergency Generator Plugs for 230 volt service shall be Russell and Stoll JRS 1044F for up to 10 HP and JRS 2044F for greater than 10 HP. Plugs for 480 volt service shall be Crouse-Hinds AR 1047 for up to 10 HP and AR204126 for greater than 10 HP.

O. Pump Disagree Sensor shall be a normally closed mercury tube switch mounted in an E condolet with rubber insulated cable mounted on the check valve lever arm. Provide ¾ inch PVC conduit from control panel to valve pit for connection of pump disagree wiring.

P. Convenience Outlet shall be a duplex GFCI 120 Volt, 60 HZ 20 amps.

2.11 VENT CAP

A. Vent cap shall be vandal-proof, hooded, and galvanized iron as manufactured by Josam 26700 Series or approved equal.

2.12 BACKFLOW PREVENTER

A. A hose bib and backflow prevention device conforming with Orlando Utilities Commission (O.U.C.) requirements shall be provided.

2.13 PRESSURE GAUGE FOR DISCHARGE LINES

A. Pressure Gauge for discharge lines shall be Red Valve Series 40 wafer thin in-line pressure sensor. Wafer shall have carbon steel body and a Buna-N Elastomer.

2.14 STATION YARD

A. Station yard shall be covered with a minimum 4 inch thickness of FDOT No. 57 white stone with a weed-blocking fabric which allows for water drainage installed underneath.

2.15 FENCING

A. Fencing fabric posts, gates, barbed wire and appurtenances shall be in accordance with the FDOT Roadway and Traffic Design Standards, latest edition, and the City of Orlando Lift Station Details and include lighting protection and proper grounding.

2.16 STAND-BY POWER

A. The wastewater utility pump station serving the AMP/ITF shall be equipped with stand-by generators. Generators shall be complete with controls, automatic switchgear and shall produce 240/480 volts, 3 phase, 4 wire power as required.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Requirements

Excavation and backfill including sheeting and bracing, dewatering, bedding and foundation, and furnishing and disposal of materials shall be as required by the FDOT and the City of Orlando.

B. Wet Wells

Wet wells shall be constructed to the same requirements as sanitary sewer manholes (see Section 333900) with the following additional requirements:

1. The base shall be monolithic with lower ring.
2. The base slab and top slab shall be constructed to the dimensions shown in the Drawings. The wall thickness and inside diameter of the wet well shall be constant over its full depth.
3. Brick construction shall not be acceptable.
4. Wet wells shall be free from all detectable leaks. Any leaks detected shall be corrected prior to final acceptance.

C. Pipe, Valves and Fittings

All exposed pipe shall have flanged joints. All buried pipes shall have mechanical joints. All exposed piping shall be coated with a minimum of 16 mils of Koppers 300M.

D. Pump Installation

Equipment shall be installed in accordance with approved shop drawings and manufacturer's instructions to operate as intended by the manufacturer. Shop drawings shall be sent to the Engineer of Record for review prior to installation of equipment. Upper guide rail holders shall be located exactly as required.

E. Control Panel

The control panel shall be factory assembled and tested prior to installation at the pump station. Contractor shall provide for coordination between pump manufacturer and panel manufacturer to assure that the control panel as a whole as well as the individual components comprises a system which is intimately compatible with the pumps. The following equipment shall be included in the panel: Main breakers, pump circuit breakers (minimum of 2), 20 amp panel circuit breaker, digital bubbler level control starters (minimum of 2), an elapsed time meter for each pump, run indicator lights (minimum of 2), HOA switches (minimum of two 2), and phase voltage monitor relay. All switches, main circuit wiring, breakers and other devices shall be clearly and neatly labeled inside the control panel. A single line wiring diagram shall be included within the panel with a copy provided for the Owner's records. Pump data for the station (HP, amps, volts, impeller size, model, etc.) shall be on a label and shall be affixed to the inside of the panel door.

F. High Level Alarm

A mercury-free float ball switch shall be provided as high level alarm to the telemetry system. Red alarm signal light shall be mounted on top of control panel enclosure. Bell or buzzer shall be mounted on outside of panel with weatherproof alarm silence button.

G. Accessory Equipment

Lightning arrester, pump disagree sensors, emergency disconnect switch, telemetry system, including antenna with mounting pole, emergency generator plug, red alarm light, bell or buzzer, level transducer mounting and convenience outlet shall be provided.

H. Emergency Power Generation

Emergency generators and related controls shall be installed per City of Orlando requirements.

I. Fencing

Construct a 6-foot, vinyl coated, chain link fence meeting FDOT Roadway and Traffic Design Standards with 1 foot of 3-stranded barbed wire. One 16-foot double swing drive gate (two 8-foot leaves) with center drop rod assembly latch (no post) and gate hold backs for both leaves shall be installed. Gate shall open outward from station. Gate drop rod receiver in driveway shall be sleeved with galvanized pipe. Fence shall be meshed with vinyl stick weave.

J. Grading

The site shall be graded away from the cover slab at a slope of 1 inch per foot.

3.2 TESTING

A. Factory Performance Tests

Manufacturer's factory performance tests and certified performance curves shall be provided for capacity power requirements and efficiency at specified minimum operating head, rated head, shut-off head and at as many other points as necessary. A copy of the certified pump curve shall be mounted on the inside of the control panel door. Two additional copies shall be provided to the Owner during start-up testing.

B. Field Testing

Field testing shall be provided by the Contractor with the pump manufacturer's representative present and witnessed by the Engineer of Record and the Owner's representative to provide a three point pump performance test by measuring the amp draw and voltage, the discharge pressure, and the rate of flow. The rate of flow and head must be within 10 percent and 5 percent, respectively, above the approved curve for acceptance.

C. Start-up and Final Inspection

The Contractor shall schedule with the Engineer of Record and the Owner for start-up and final inspection at the completion of the work. After final inspection is complete, the Contractor shall provide the Owner with two copies of the station O&M manual.

END OF SECTION 33 32 19

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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	D1557
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	
Diameter	% Slope
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 33 33 00

SECTION 03 31 15 – CURED-IN-PLACE (CIPP)

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 of the installation of a resin-impregnated flexible tube, which is formed to the proposed gravity sewer main, by use a hydrostatic head or air pressure. The resin is cured using either hot water under hydrostatic pressure or steam within the tube. The Cured-In-Place Pipe (CIPP) will be continuous and tight fitting.

1.2 REFERENCES

A. This specification references ASTM F1216 (Rehabilitation of pipelines by the inversion and curing of a resin-impregnated tube), ASTM F1743 (Rehabilitation of pipelines by pulled-in-place installation of a cured-in-place thermosetting resin pipe), and ASTM D790 (Test methods for flexural properties of non-reinforced plastics) which are made a part hereof by such reference and shall be the latest edition and revision thereof. In case of conflicting requirements between this specification and these referenced documents, this specification will govern.

1.3 CONTRACTOR QUALIFICATION REQUIREMENTS

A. CIPP Contractor, as a firm, shall have a minimum of five years of experience self-performing similar CIPP installations in the State of Florida, including pipelines of the same or larger diameter and the same or greater lengths, verified by documented references and must be submitted with the bid. The Contractor, as a firm, shall also have successfully completed at a minimum of five (5) similar projects of the same or larger diameter and of equal or greater length. Additionally, the Contractor as a firm shall have successfully installed with its own workforces, a minimum of 500,000 LF of cured-in-place pipe in the State of Florida.

B. Contractor shall have prior experience working with the City of Orlando Wastewater Division. Acceptable Contractors are Layne Inliner, LLC; Miller Pipeline Corp.; Insituform Technologies, LLC; or approved substitution.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Tube - The sewn tube shall consist of one or more layers of absorbent non-woven felt fabric and meet the requirements of ASTM F1216 or ASTM F1743, Section 5, reinforcing fibers may be included. The tube shall be constructed to withstand installation pressures, have sufficient strength to bridge missing pipe, and stretch to fit irregular pipe sections.

B. The wet out tube shall have a uniform thickness that when compressed at installation pressures will meet or exceed the design thickness, per section 2.2, F.

C. The tube shall be sewn to a size that when installed will tightly fit the internal circumference and length of the original pipe. Allowance should be made for circumferential stretching during installation.

D. The inner or outer layer of the tube (before wet out) shall be coated with an impermeable, flexible membrane that will contain the resin and facilitate monitoring of resin saturation during the resin impregnation (wet out) procedure.

E. The tube shall be homogeneous across the entire wall thickness containing no intermediate or encapsulated elastomeric layers. No material shall be included in the tube that may cause delamination in the cured CIPP. No dry or unsaturated layers shall be evident.

F. The wall color of the interior pipe surface of CIPP after installation shall be a light reflective color so that a clear detailed examination with closed circuit television inspection equipment may be made.

G. Seams in the tube shall be stronger than the non-seamed felt.

H. The outside of the tube shall be marked for distance at regular intervals along its entire length, not to exceed 5 ft. Such markings shall include the manufacturers name or identifying symbol. The tubes must be manufactured in the USA.

I. Resin - The resin system shall be a corrosion resistant polyester or vinyl ester and catalyst system that when properly cured within the tube composite meets the requirements of ASTM F1216 and ASTM F1743, the physical properties herein, and those which are to be utilized in the design of the CIPP for this project. The resin shall produce CIPP which will comply with the structural and chemical resistance requirements of this specification.

2.2 STRUCTURAL REQUIREMENTS

A. The CIPP shall be designed as per ASTM F1216, Appendix X.1. The CIPP design shall assume no bonding to the original pipe wall.

B. The Contractor must submit long-term testing for flexural creep in accordance with ASTM D2990 of the CIPP pipe material installed by his Company. Such testing results are to be used to determine the long-term, time dependent flexural modulus to be utilized in the product design. A percentage of the instantaneous flexural modulus value (as measured by ASTM D-790 testing) will be used in design calculations for external buckling. The percentage, or the long-term creep retention

value utilized, will be verified by the ASTM D2990 testing. Values in excess of 50% will not be applied unless substantiated by qualified third party test data. The materials utilized for the contracted project shall be of a quality equal to or better than the materials used in the long-term test with respect to the initial flexural modulus used in design.

C. The enhancement factor 'K' to be used in 'Partially Deteriorated' design conditions shall be assigned a value of 7.

D. The layers of the cured CIPP shall be uniformly bonded. It shall not be possible to separate any two layers with a probe or point of a knife blade so that the layers separate cleanly or the probe or knife blade moves freely between the layers. If separation of the layers occurs during testing of field samples, new samples will be cut from the work. Any reoccurrence may cause rejection of the work.

E. The cured pipe material (CIPP) shall conform to the structural properties, as listed below.

MINIMUM PHYSICAL PROPERTIES

Composite Property	Test Method	Cured Composite min. per ASTM F1216	Cured (400,000 psi Resin)
Modulus of Elasticity	ASTM D-790 (short term)	250,000 psi	400,000 psi
Flexural Stress 4,500 psi	ASTM D-790	4,500 psi	

F. The required structural CIPP wall thickness shall be based as a minimum, on the physical properties in Section 2.2, E and in accordance with the design equations in the appendix of ASTM F 1216, and the following design parameters:

Design Safety Factor = 2.0
Retention Factor for Long-Term Flexural Modulus to be used in Design = 50% - 75%
(*as determined by Long-Term tests described in paragraph 2.2, B)*
Ovality* = 2%
Enhancement Factor, k = 7
Groundwater Depth (above invert)* = ft.
Soil Depth (above crown)* = ft.
Soil Modulus** = psi
Soil Density** = 120 pcf
Live Load** = H20 Highway

Design Condition (partially or fully deteriorated)*** =_____

* Denotes information which can be provided here or in inspection video tapes or project construction plans. Multiple line segments may require a table of values.
** Denotes information required only for fully deteriorated design conditions.
*** Based on review of video logs, conditions of pipeline can be fully or partially deteriorated. (See ASTM F1216 Appendix) The Owner will be sole judge as to pipe conditions and parameters utilized in Design.

G. Any layers of the tube that are not saturated with resin prior to insertion into the existing pipe shall not be included in the structural CIPP wall thickness computation.

PART 3 – EXECUTION

3.1 TESTING REQUIREMENTS

A. Chemical Resistance - The CIPP shall meet the chemical resistance requirements of ASTM F1216, Appendix X2. CIPP samples for testing shall be of tube and resin system similar to that proposed for actual construction. It is required that CIPP samples with and without plastic coating meet these chemical testing requirements.

B. Hydraulic Capacity - Overall, the hydraulic profile shall be maintained as large as possible. The CIPP shall have a minimum of the full flow capacity of the original pipe before rehabilitation. Calculated capacities may be derived using a commonly accepted roughness coefficient for the existing pipe material taking into consideration its age and condition.

C. CIPP Field Samples - When requested by the Owner, the Contractor shall submit test results from past field installations in North America of the same resin system and tube materials as proposed for the actual installation. These test results must verify that the CIPP physical properties specified in Section 2.2, E, have been achieved in previous field applications.

3.2 INSTALLATION RESPONSIBILITIES FOR INCIDENTAL ITEMS

A. It shall be the responsibility of the Contractor to locate and designate all manhole access points open and accessible for the work, and provide access to these points. The Contractor shall also provide access to water for cleaning, inversion and other work items requiring water.

B. Cleaning of Sewer Lines - The Contractor, when required, shall remove all internal debris out of the sewer line that will interfere with the installation of CIPP.

C. Inspection of Pipelines - Inspection of pipelines shall be performed by experienced personnel trained in locating breaks, obstacles and service connections by close circuit television. The interior of the pipeline shall be carefully inspected to determine the location of any conditions which may prevent proper installation of

CIPP into the pipelines, and it shall be noted so that these conditions can be corrected. A video tape and suitable log shall be kept for later reference by the Owner.

D. Line Obstructions - It shall be the responsibility of the Contractor to clear the line of obstructions such as solids and roots that will prevent the insertion of CIPP. If pre-installation inspection reveals an obstruction such as a protruding service connection, dropped joint, or a collapse that will prevent the inversion or pull-in installation, that was not evident on the pre-bid video and it cannot be removed by conventional sewer cleaning equipment, then the Contractor shall make a point repair excavation to uncover and remove or repair the obstruction. Such excavation shall be approved in writing by the Owner's representative prior to the commencement of the work.

E. The Contractor shall be responsible for confirming the locations of all branch service connections prior to installing and curing the CIPP.

3.3 INSTALLATION

A. CIPP installation shall be in accordance with ASTM F1216, Section 7, or ASTM F1743, Section 6, with the following modifications:

B. Resin Impregnation - The quantity of resin used for tube impregnation shall be sufficient to fill the volume of air voids in the tube with additional allowances for polymerization shrinkage and the loss of resin through cracks and irregularities in the original pipe wall. A vacuum impregnation process shall be used. To insure thorough resin saturation throughout the length of the felt tube, the point of vacuum shall be no further than 25 feet from the point of initial resin introduction.

C. After vacuum in the tube is established, a vacuum point shall be no further than 75 feet from the leading edge of the resin. The leading edge of the resin slug shall be as near to perpendicular as possible. A roller system shall be used to uniformly distribute the resin throughout the tube. If the Installer uses an alternate method of resin impregnation, the method must produce the same results. Any alternate resin impregnation method must be proven.

1. Tube Insertion – The wet out tube shall be positioned in the pipeline using either
inversion or a pull-in method. If pulled into place, a power winch should be utilized and care should be exercised not to damage the tube as a result of pull-in friction. The tube should be pulled-in or inverted through an existing manhole or approved access point and fully extend to the next designated manhole or termination point.

2. Temperature gauges shall be placed inside the tube at the invert level of each end to monitor the temperatures during the cure cycle.

3. Curing shall be accomplished by utilizing either hot water under hydrostatic pressure or steam in accordance with the manufacturer's recommended cure schedule.

3.4 REINSTATEMENT OF BRANCH CONNECTIONS

A. It is the intent of these specifications that branch connections to buildings be reopened without excavation, utilizing a remote controlled cutting device, monitored by a video TV camera. The Contractor shall certify he has a minimum of 2 complete working cutters plus spare key components on the site before each inversion. Unless otherwise directed by the owner or his authorized representative, all laterals will be reinstated. No additional payment will be made for excavations for the purpose of reopening connections and the Contractor will be responsible for all costs and liability associated with such excavation and restoration work.

3.5 INSPECTION

A. For each section of pipe between manholes, one CIPP sample for each diameter shall be prepared and physical properties tested in accordance with ASTM F1216 or ASTM F1743, Section 8, using either method proposed. The flexural properties must meet or exceed the values listed in Table 1 of the applicable ASTM.

B. Wall thickness of samples shall be determined as described in paragraph 8.1.6 of ASTM F1743. The minimum wall thickness at any point shall not be less than 87½% of the design thickness as calculated in paragraph 5.6 of this document.

C. Visual inspection of the CIPP shall be in accordance with ASTM F1743, Section 8.6.

3.6 CLEAN-UP

A. Upon acceptance of the installation work and testing, the Contractor shall restore the project area affected by the operations to a condition at least equal to that existing prior to the work.

END OF SECTION 33 33 15

SECTION 33 34 00 – SANITARY UTILITY SEWERAGE FORCE MAINS

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 utility sewerage force mains and appurtenances, including excavation, trenching, backfilling, testing and appurtenant work as required.

1.3 MAINTAINING 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. 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 piping specialties.

B. Product Data: Submit data on pipe materials, pipe fittings, pipe restraints, 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 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 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 shall conform to AWWA C900, DR 18, Pressure Class 150 or approved equal with an integral bell and spigot joint conforming to ASTM D3 139. For pipe diameters less than 4", provide pressure rated PVC schedule 80 pipe and fittings. PVC pipe shall use ductile iron or PVC fittings for less than 4-inch diameter and ductile iron fittings for larger pipe.

2.2 DUCTILE IRON PIPE (DIP) AND FITTINGS

A. The pipe shall be of ductile iron (DI) Class 350 (4-12 inch), Class 250 (14-20 inch), Class 200 (24 inch), and Class 150 (30-64 inch). Fittings shall be ANSI/AWWA C110/A21.10 ductile iron unless otherwise noted. Pipe and fittings shall be manufactured by American Pipe, U.S. Pipe, or approved equal.

B. 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 Carboline 300M, or an approved equal.

2.3 PLUG VALVES

A. Plug valves shall have a semi-steel body, non-lubricated, eccentric type, 100% port opening, with resilient faced plugs capable of drip-tight bi-directional shut-off at the full rated pressure. Valves shall be lined with a factory applied ceramic epoxy material such as SP2000 or Protecto 401, or an approved equal. Exposed valves shall have flanged connections. Buried valves shall have mechanical joint connections. Buried valves shall have stem extensions which shall bring the operating nut within two feet of finished grade. Stem extension shall be contained within an appropriately sized valve box. Gear actuators for valves 8 inches or larger shall be provided. Valves and appurtenances shall be Series 100 as manufactured by DeZurik Corp., Milliken, Val-Matic, or approved equal.

2.4 AIR RELEASE VALVES

A. Air Release Valves, below grade, shall be Crispin, Val-Matic, H-Tec, or ARI Pressure Sewer Valves and above grade shall be only H-Tec. The valve(s) shall be of the long body design and orifice with an adjustable BUNA-N rubber valve and a sealing face of

PVC. Three-inch and smaller shall be threaded N.P.T. connection. Four-inch and larger shall be ASNSI Class (125,250) flanged connection. All piping shall be 316 Stainless Steel. Isolation valves for the air release shall be cast iron body plug valves with 316 Stainless Steel Trim and buried service actuator as manufactured by Dezurik, or approved equal as shown on the Wastewater Division standard details. All offset air release valve vaults shall have isolation plug valves located outside and adjacent to the valve vault.

2.5 TAPPING SLEEVES AND VALVES

A. Tapping sleeves and valves shall be a joint type with flanged outlet per ANSI B 16.1, Class 125 equal to M and H Fig. 74-M (Tapping Sleeve) manufactured by Dresser Industries, Inc., Anniston, Alabama or as approved by the Wastewater Division. Sleeve shall be epoxy coated or stainless steel with stainless steel hardware. Tapping valve shall be installed horizontally. An isolation valve (plug valve) shall be installed adjacent to the tapping Valve. Tapping Valves shall be gate valves specially designed for wet tapping and compatible with the connecting sleeve and with a sanitary sewer application.

2.6 VALVE BOXES

A. Valve boxes shall be adjustable, cast iron and suitably sized to the valve with a minimum diameter of 5 inches. The cover shall have the word “SEWER”: legibly cast into the face. Boxes shall be suitable for H-20 loading and equal to Clow, M and H, or U. S. Foundry. Valve boxes shall be labeled to identify type of valve, depth and number of turns required on a brass marker permanently affixed to the valve box cover.

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 as required in Section 333300.

3.2 PIPE LAYING

A. All pipe shall be laid “in the dry” along straight lines and grades between fittings other defined points, unless definite alignment deflections or grade changes are necessary. The standard minimum cover for sewage force main systems shall be 3 feet from the top of the pipe to finish grade. Where waterways, canals, ditches or other cuts are crossed, a protective casing should be bored and jacked beneath the waterway where possible and the pipe installed in the casing. Additionally, utility crossing signs shall be placed on the pipe alignment at each side of the canal, etc. All materials shall be maintained and all coatings shall be protected from damage and kept clean. The interior of the pipe shall be maintained clean and free of dirt and debris. When work is not in progress, all open ends must be plugged off to prevent debris from entering pipe. Underground piping shall not be driven to grade by striking it with an unyielding object. Bell holes in the bedding shall be provided to allow uniform load bearing along the pipe barrel.

3.3 PUSH-ON JOINTS

A. The pipe bell and spigot shall be thoroughly cleaned immediately prior to inserting the gasket and jointing. The gasket shall be properly faced and positioned. Lubrication shall be in accordance with the manufacturer's recommendations. Pipe shall be protected against damage from jointing equipment by using timber headers, etc. Damaged bells or spigot ends will not be accepted.

3.4 MECHANICAL JOINTS

A. The socket and plain end shall be wiped clean. The plain end, socket and gasket shall be washed with a soap solution immediately prior to jointing. The joint shall be kept straight during assembly with the gasket pressed firm and even into the recess. Bolts shall be tightened such that the gland remains reasonably parallel to the flange by alternating from bolt to bolt in cycles. Gaskets damaged during installation, shall be replaced at no cost to the City.

3.5 FLANGE JOINTS

A. Make all flanged joints tight, without applying undue strain upon the joint or other appurtenances. Joints shall be fitted such that contact surfaces bear uniformly on the gasket with relatively uniform bolt stresses.

3.6 CONNECTIONS AT STRUCTURES

A. Where pipes are to extend into or through structures, Link Seal-Type penetration seals shall be provided at the wall face. Openings in existing structures shall be made with a circular core boring machine.

3.7 PIPE CUTTING

A. Cutting of pipes for the insertion of valves, fittings or closure pieces shall be done in a neat workmanlike manner without damaging pipe coatings or linings. The pipe shall be cut with an abrasive pipe saw, rotary wheel cutter, guillotine pipe saw or milling wheel saw. Cut ends and rough edges shall be ground smooth and for push-on joint connections, the cut end shall be beveled. Where castings or linings have been damaged, use a solvent to clean the affected area, abrade the surface, and then field apply Protecto 401 or SP 2000 repair kit to the original film thickness specified.

3.8 PIPE RESTRAINT

A. Pipe restraint shall be in accordance with Section 330519.

3.9 POLYTETHYLENE ENCASEMENT

A. Extra protection shall be provided for underground cast or ductile iron pipe and fittings within areas of severe corrosive conditions. This shall be accomplished by the installation of polyethylene encasement through the area of concern. The soil-test evaluation to determine the necessity for extra protection in suspect areas shall be as set forth in ANSI Standard A2 1.5.

3.10 ABOVE GROUND PIPE SUPPORT

A. Support exposed systems as necessary to hold the pipe and appurtenances in a firm substantial manner to the required lines and grades with no undue piping stresses or bending. All pipe above ground outside of buildings shall be supported by concrete supports or appropriate hangers.

3.11 CONNECTIONS

A. Where dry connections are feasible and allowed by the Wastewater Division where a new branch is to be connected at an existing force main, a wye fitting shall be used. Wet tapping shall be by tapping sleeve and valve installed with a tapping device designed for the pipe material. Tapping sleeves are recommended for receiving mains of 24-inches or larger. Size on size wet taps shall not be allowed. Tapping of force mains shall be only where approved by the Wastewater Division. Tapping of force mains shall be only where approved by the Wastewater Division.

3.12 VALVE INSTALLATION

A. Valves shall be installed on all subsidiary force mains at the point of connection to the major main, in order to isolate said pipeline for maintenance. Where force mains are to be extended, valves shall be placed at the future connection points so as to preclude line shut-down at the time of extension. All valves shall be opened wide and then tightly closed. Nuts and bolts shall be inspected for tightness. Special care shall be taken to prevent joint materials, stones and other substances from becoming lodged in the valve seat. Any valve that does not operate correctly shall be replaced.

B. Unless otherwise noted and approved by the Wastewater Division, lay valves on side such that the plug rotates to the top of the pipe when in the open position. Where extension stems are required within valve boxes, insert stems shall be provided.

3.13 VALVE BOXES

A. All valve boxes shall be centered over the operating nut of underground valves to permit a valve wrench to be easily fitted to the nut. Top of boxes shall be set to final grade. The valve box shall not transmit surface loads directly to either the pipe or valve. Care shall be used to prevent earth and other materials from entering the boxes. Any valve box that becomes out of alignment or is not to grade shall be dug out and adjusted. A concrete collar which identifies the valve shall be provided as shown in the ESM Details.

3.14 AIR AND VACUUM VALVES

A. Where the force main profile is such that air pockets or entrapment could occur, air release/vacuum valves shall be provided. Automatic air release assemblies shall be installed, where venting is required, on all major force mains and at critical points on lesser mains. At profile break points on major force mains, such as tops of hills, etc., where free flow will occur during operation or after pumping stops, combined air release and vacuum valve assemblies shall be provided. Air and vacuum valves and/or air release valves shall be suitably housed in a properly vented underground valve vault as shown in Standard Detail Drawings.

3.15 TERMINAL DISCHARGE

A. Force mains shall enter the terminal facility, gravity sewer manhole, pumping station wet well or other, at a point equal to the operational water level of said receiving unit. Force mains entering manholes shall enter so that flow is in the same direction as the outlet pipe and at an elevation no greater that the top of outlet pipe. Should an elevation drop be required to obtain the outlet connection, the prior down-slope of the force main shall not exceed 45 degrees unless prior approval is obtained from the Wastewater Division. Adequate air venting shall be provided at the profile break-point. Manholes which receive discharge from a force main shall be lined in accordance with the requirements of the City's ESM.

3.16 IDENTIFICATION

A. In order to preclude possible domestic water tapping, all installed underground sanitary sewage force mains shall be green in color or shall be marked with continuous stripes painted at the 12 o'clock, 3 o'clock and 9 o'clock positions of the pipe. Each stripe shall be a minimum 2 inches in width and shall be light green in color. Backfill shall not be placed for 30 minutes following paint application. In addition, all pipe shall be buried with identification tape above the top of the pipe. The tape shall indicate the presence of a sanitary force main plainly on the tape face. Indicator tape buried with PVC pipe shall be able to be detected by standard metal detection equipment, as manufactured by Terra Tape Detectable or approved equal.

B. Green sewer locate balls shall be buried with a depth of 3-4 feet below finished grade.

C. In addition, 8 gauge solid copper locate wire attached to the entire length of non-metallic sewer force main shall be installed in accordance with the City standard detail drawings.

3.17 HYDROSTATIC TESTING

A. This test shall be performed by the contractor with his labor and equipment in the presence of the City Engineer (or designee), and the engineer of record (EOR). No testing shall proceed until all restraining devices installed. Clean and flush all piping thoroughly prior to testing. The amount of water to be used for cleaning shall be twice the volume of the pipe being tested and the velocity of flow should be a minimum of 3 feet per second (fps). During filling of water, all air shall be carefully permitted to escape through release

cocks installed as required. The hydrostatic test shall be performed at 150 pounds square inch (psi) for a period of two hours. Following stabilization of the pressure reading, there shall be no allowable leakage.

B. During the 2 hour period of the test, the contractor shall maintain a continuous pressure of 150 psi by means of a pump taking supply from a container suitable for the measurement of water loss. Should the test fail, the leak(s) will be located and repaired and the test performed again until it meets the above specified limits. The test results shall be documented in a report signed and sealed by the EOR submitted to the City.

END OF SECTION 33 34 00

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SECTION 33 39 00 – SANITARY UTILITY SEWERAGE STRUCTURES

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 utility sewerage structures, including excavation, backfilling, testing and appurtenant work as required.

1.3 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.

1.4 SUBMITTALS

A. Shop Drawings: Showing dimensions and invert elevations.

B. Product Data: Submit data on materials and accessories.

C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

D. Project Record Documents: Record actual locations of structures and invert elevations. As-built drawings shall follow requirements stated in Chapter 5 of the City of Orlando Engineering Standards Manual, latest edition, Found in Appendix A (attached).

1.5 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 GENERAL REQUIREMENTS

A. Manholes shall be in accordance with the Drawings. Manholes shall be precast concrete with integral bottom slab and lower ring, poured in place concrete slab with precast ring wall, or mortared brick wall construction. All manholes shall be bitumastic coated.

2.2 PRECAST MANHOLES

A. All manholes shall have a minimum wall thickness of eight inches. Manholes shall be manufactured with 4,000 P.S.I. concrete, Type II cement. Wall reinforcement shall meet ASTM-478 and also have a No. 4 rebar hoop around each pipe opening. Bottom slabs will be 8 inches thick and be reinforced with No. 4 @ 9 inches O.C.E.W. All items will be wet cast. Dry casting or low slump concrete will not be allowed. All bases will have proper lifting hooks in the bottom slabs (min. of 3) and there will be no penetrating lifting holes on any structures. No holes will be allowed within 6 inches of any joint on structures. Concentric cone sections are required.

2.3 PIPE-MANHOLE CONNECTOR

Connection to pipes less than 12-inch diameter shall be with Kor-N-Seal or Link Seal, for pipes 12-inch diameter and larger, where invert depth exceeds 10 feet for all pipe type and diameters, and for all DIP use Link Seal. Other proposed connectors must be approved by the Water Reclamation Division.

2.4 NON-SHRINK MORTAR

A. All holes in manholes shall be thoroughly plugged with an approved non-shrinking mortar, applied and cured in strict conformance with the manufacturer's recommendations. The mortar shall be finished smooth and flush with the adjoining interior and exterior manhole and wetwell wall surfaces. When mortar is set, coat with Koppers 300 M coal tar epoxy 16 mils dry thickness.

2.5 BRICK AND MORTAR

A. Brick manhole construction is prohibited. Bricks may be used for adjustment of manhole frames. Brick shall conform to ASTM C32, grade MC (hard brick). For brick sections of manholes, mix one part Portland Cement Type II and three parts of sand per FDOT 902-2. For mortar plaster, use one part cement and two parts sand.

2.6 MANHOLE JOINT SEALER

A. A pre-formed plastic joint sealer such as "Ram-Nek" as manufactured by the K. T. Snyder Co., Inc., or approved equal shall be required. All exterior joints shall be sealed with Portland type II cement after the setting of the Ramnek and placement of each manhole section to form a water-tight joint. Manhole joints and ring and cover chimney shall be wrapped with adhesive polyolefin sheeting that is heat applied to the exterior of the structure. Upon cooling, the adhesive shall form a tough, elastomeric protective layer that shall effectively prevent the infiltration of groundwater through these areas. The overall thickness of the applied sleeve shall nominally be 2.5 mm. Wrap material shall be Wrapid Seal or approved equal.

2.7 MANHOLE FRAME AND COVERS

A. Manhole frame and covers shall be manufactured by U.S. Foundry or approved equal. Manhole frames and covers shall be standard 2-piece heavy duty with machine bearing surfaces, no hinged covers (see standard details). The word “Sanitary Sewer” and the logo of the “City of Orlando” shall be cast into the face of the cover in accordance with the standard details. Manholes for privately owned systems shall have the word “Private Sanitary Sewer” cast into the face of the cover, shall not bear the City Seal Logo. See Drawings for manhole cover markings.

2.8 MANHOLE COATING

A. Two coats of bitumastic (Carboline No. 300M or an approved equal) shall be applied to all interior and exterior surfaces by the precast manufacturer at a rate necessary to achieve a 16 mil dry film thickness. All disturbed and uncoated surfaces shall be coated in the field. This work shall be accomplished prior to T.V. inspection. The first two (2) manholes upstream of a lift station and manholes that receive force main discharge shall have interior liners or epoxy coating approved by the Water Reclamation Division. Liners shall be either a solid wall fiberglass liner or an integrally cast fiberglass or polyethylene liner and be provided by GUliner or AGRU Liner. Rings and covers in these manholes shall be coated with a corrosion resistant epoxy.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Manhole excavation 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 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.

3.3 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.

3.4 STABILIZATION

A. If portions of the bottom of 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 structure, 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.

3.5 MANHOLE FOUNDATION

A. The soil beneath the manhole shall be compacted to 98% of maximum (modified Proctor AASHTO T - 180) density for twelve inches and then stabilized using a minimum of 12" of 57 stone.

3.6 MANHOLE BASE AND INVERT

A. Bases shall be poured in place with Type II Portland cement concrete or cast as an integral part of the precast section. On precast structures, the manhole shall be trowel finished concrete benching and invert channels provided in accordance with the City standard detail drawings. The Water Reclamation Division may require the manhole base be cast with an integral base liner system which shall also form the invert channel(s). The base liner shall be of polyethylene or fiber reinforced plastic (FRP) and shall be a non-load bearing component of the structure. The liner shall be anchored into the base during the casting process at the precast manufacturer's facility. The liner shall include full flow channels, an anti-skid pattern on the bench surface and a means of making a leak-free pipe connection.

3.7 TOP ELEVATION

A. Precast manhole top shall be adjustable between six inches and 12 inches by means of bricks laid in mortar or precast riser rings. Vertical walls of manhole entrances shall be a maximum of 18 inches in length, including the ring and cover.

3.8 MANHOLE FRAMES AND COVERS

A. Manhole frames and covers shall be set to conform to the finish grades. All frames shall be set securely in a cement mortar bed and fillet. All covers shall be made flush with

existing permanent surfaces except outside the limits of the traveled ways where they should be set approximately 0.2 foot above the existing ground unless otherwise noted.

3.9 BACKFILLING

A. Backfill shall be granular material approved for use by the City of Orlando and/or Engineer. 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 City of Orlando and/or Engineer, 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,	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	D1557
Granular Fill	Below concrete slab bedding, foundations, rigid paving and excavated areas adjacent to structures	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.

3.10 STUBS AND STOPPERS

A. Pipe stoppers shall be installed in all manhole stubs. When connecting to an existing stub and prior to removing the existing stopper, brick the inside opening to prevent any flow until the new system has been tested and cleaned. The brick shall not be removed until the final inspection.

3.11 BULKHEADING STUB CHANNELS

A. The downstream end of all outlets in the manholes of stub-out-channels not in use shall be bulkheaded to prevent the creation of a septic condition resulting from ponding of sewage or debris in the unused channel.

3.12 DROP CONNECTIONS

A. A drop connection shall be required for invert elevation differences greater than 18 inches. Benches shall be built up to the 0.8D point of all incoming pipes for invert elevation differences greater than 12 inches. Outside drop connections are not allowed. Minimum inside manhole diameter shall be 5 feet for drop manholes. Drop connections should be avoided and must receive prior approval of the Water Reclamation Division. Drop connections are discouraged except in extreme cases, only pipe diameters less than 10-inches, and must be approved by the Water Reclamation Division.

3.13 TESTING

A. Closed-circuit television inspection shall be conducted in accordance with Section 330130.

B. Sewer manholes shall be vacuum tested in accordance with the procedures and Standards in ASTM C1244.

C. Should the CCTV inspection reveal any defects or if the vacuum test fails, necessary repairs shall be accomplished by the Contractor and the test repeated until within the established limits. The Contractor shall furnish the necessary labor, equipment, and all other items necessary to conduct the required testing and perform the necessary system repairs required to comply with the specified test.

D. 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.

E. 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 33 39 00

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SECTION 33 49 13 – NYLOPLAST DRAINAGE BASINS

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. PVC surface drainage inlets shall include the drain basin type as indicated on the contract drawing and referenced within the contract specifications. The ductile iron grates for each of these fittings are to be considered an integral part of the surface drainage inlet and shall be furnished by the same manufacturer. The surface drainage inlets shall be as manufactured by Nyloplast a division of Advanced Drainage Systems, Inc., or approved substitution.

PART 2 - PRODUCTS

2.1 MATERIALS

A. The drain basins required for this contract shall be manufactured from PVC pipe stock, utilizing a thermoforming process to reform the pipe stock to the specified configuration. The drainage pipe connection stubs shall be manufactured from PVC pipe stock and formed to provide a watertight connection with the specified pipe system. This joint tightness shall conform to ASTM D3212 for joints for drain and sewer plastic pipe using flexible elastomeric seals. The flexible elastomeric seals shall conform to ASTM F477. The pipe bell spigot shall be joined to the main body of the drain basin or catch basin. The raw material used to manufacture the pipe stock that is used to manufacture the main body and pipe stubs of the surface drainage inlets shall conform to ASTM D1784 cell class 12454.

B. The grates and frames furnished for all surface drainage inlets shall be ductile iron for sizes 8”, 10”, 12”, 15”, 18”, 24”, 30” and shall be made specifically for each basin so as to provide a round bottom flange that closely matches the diameter of the surface drainage inlet. Grates for drain basins shall be capable of supporting various wheel loads as specified by Nyloplast. 12” and 15” square grates will be hinged to the frame using pins. Ductile iron used in the manufacture of the castings shall conform to ASTM A536 grade 70-50-05. Grates and covers shall be provided painted black.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The specified PVC surface drainage inlet shall be installed using conventional flexible pipe backfill materials and procedures. The backfill material shall be crushed stone or other granular material meeting the requirements of class 1 or class 2 materials as defined in ASTM D2321. Bedding and backfill for surface drainage inlets shall be well placed and compacted uniformly in accordance with ASTM D2321. The drain basin will be cut at the time of the final grade. No brick, stone or concrete block will be required to set the grate to the final grade height. For load rated installations, a concrete slab shall be poured under and the grate and frame. The concrete slab must be designed taking into consideration local soil conditions, traffic loading, and other applicable design factors. For other installation considerations such as migration of fines, ground water, and soft foundations refer to ASTM D2321 guidelines.

PART 4 – SUBMITTALS

4.1 SHOP DRAWINGS

A. Shop drawings for each Nyloplast Drainage Basin, manhole, junction box, and yard drain shall be submitted to OAR for review prior to fabrication.

PART 5 – METHOD OF MEASUREMENT AND BASIS OF PAYMENT

5.1 METHOD OF MEASUREMENT

A. The quantities to be paid for will be the number of Nyloplast Drainage Basins, manholes, junction boxes, and yard drains, completed and accepted.

5.2 BASIS OF PAYMENT

A. Price and payment will be for full compensation for furnishing all materials and completing all work described herein or shown in the Plans, including all clearing and grubbing outside the limits of clearing and grubbing as shown in the Plans, all excavation except the volume included in the measurement designated to be paid for under the items for the grading work on the project, all backfilling around the structures, the disposal of surplus material, and the furnishing and placing of all gratings, frames, covers, and any other necessary fittings.

END OF SECTION 33 49 13

SECTION 33 52 43 - AVIATION FUELING SYSTEM GENERAL REQUIREMENTS

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. Furnish all labor, equipment and material for the complete installation of the aircraft fueling system as indicated and specified.

B. All Work related to the aircraft fueling system specified in DIVISION 33 and shown on the Plans shall be performed by an experienced Aircraft Hydrant Fuel System Contractor or Subcontractor meeting the following qualifications:

1. The Contractor or Subcontractor shall be a Florida Licensed Mechanical Contractor and a Florida Licensed Pollutant Storage System Specialty Contractor experienced in the construction of underground aircraft hydrant fuel systems within active Aircraft Operations Areas (AOA). The Contractor or Subcontractor shall have a minimum of ten years' experience constructing underground aircraft hydrant fuel systems equal to or greater than the scope of work in this contract.

2. Within the last seven years the Contractor or Subcontractor shall have constructed at least three underground aircraft hydrant fuel systems with a value greater than or equal to $1,250,000.00 each and including at least 2,000 linear feet of 12 inch or larger fuel pipe, 20 or more hydrant fuel pits, one or more isolation valve pits, and one or more control valve vaults. One of the three above projects shall include the installation of 12 inch or larger double wall fuel pipe according to Florida Regulations.

3. The Project Manager and Superintendent for the Contractor or Subcontractor shall have each completed a minimum of three underground aircraft hydrant fuel systems of a size equal to or greater than the work in this contract.

4. The Contractor or Subcontractor shall submit letters of reference from airlines or airport administrations attesting to their abilities and past performance to perform hydrant fuel system construction of a size equal to or greater than the scope of work in this contract.

5. The Owner's shall determine the acceptability of all submitted information and approve or disapprove the submitted Aircraft Hydrant Fuel System Contractor or Subcontractor.

1.3 ACTION SUBMITTALS:

A. Submittals shall constitute a representation to Owner and Owner's Authorized Representative that Contractor has either determined or verified all quantities, dimensions, field construction criteria, materials, catalog numbers and similar data or he assumes full responsibility for doing so, and that he has coordinated each Submittal with the requirements of the Work and the Contract Documents. Contractor certifies that the Material and Equipment shown and marked on the Submittals are in compliance with the Contract Documents and can be installed, operated, and maintained in the allocated space.

B. Submit as specified in the individual Specifications sections, Plans and other Contract Documents.

C. Submittals shall constitute a representation to the Owner and the Owner's Authorized Representative that the Contractor has either determined or verified all quantities, dimensions, field construction criteria, materials, catalog numbers and similar data or that the Contractor assumes full responsibility for doing so, and that the Contractor has coordinated each Submittal with the requirements of the Work and the Contract Documents. Contractor certifies that the equipment and materials shown and marked on the Submittals are in compliance with the Contract Documents and can be installed, operated, and maintained in the allocated space.

D. Include, but not limited to, the following:

1. Piping fabrication drawings:

a. Include in-plan view of all systems piping 2-1/2 inches and larger. Provide isometrics for piping systems or tubing 2 inches in diameter and smaller.

b. Show the actual equipment furnished, equipment location by dimension, and connections.

c. Dimension pipelines in plan view and locate in elevation. Indicate support locations.

d. Submit before beginning fabrication.

e. All drawings shall be provided in AutoCAD.

2. Supports:

a. Detailed drawings of support assemblies indicating the following:

i. Plan and elevation of piping.

ii. Plan and elevation of support components.

iii. Complete Bill of Materials.

iv. Tag designation.

v. Erection requirements including field weld sizes and weld rod requirements.

vi. Concrete pad, grout, and foundation details.

3. Pumps and motors.
4. Filter/Separators and Accessories.
5. Manual Operated Valves.
6. Control Valves.
7. Pressure gauges
8. Coating Materials.
9. Fiberglass Pit Assemblies.
10. Prefabricated Valve Pits and Covers.
11. Pipe, Fittings and Accessories.
12. Pipe Supports.
13. Control System.
14. Leak Detection System.
15. Welding qualification and procedures.
16. Welder certificates signed by the Contractor certifying that welders comply with requirements specified under “Quality Assurance” Article.
17. Installation and erection instruction books and maintenance manuals including, but not limited to, the following:
    a. Pump and Motors.
    b. Filter/Separators and Accessories.
    c. Manual Operated Valves.
    d. Motor Operated Valves.
    e. Control Valves.
    f. Meters, Gauges and Transmitters.
    g. Leak Detection System.
    h. Control System.
    i. Fittings and Special Materials.
    j. Prefabricated Pit Assemblies, and Valve Vault and Valve Pit Access Covers and Ladders.
18. Bind all instruction books and manuals complete in three-ring binders with hard durable covers clearly and permanently identified with Contract name and number.
19. Each manual shall include the equipment purchase order.

1.4 QUALITY ASSURANCE:

A. Acceptable Manufacturers: Specified in each Section of DIVISION 33.

B. All Equipment and Materials shall be the latest design, new, and the first quality standard product of manufacturers regularly engaged in the production of such Equipment and Materials for a minimum of 5 years.

C. When two or more units of the same class of Equipment are required, they shall be products of a single manufacturer.

D. Qualify welding processes and welding operators in accordance with ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."

~~E. Contractor or any Subcontractor or Supplier shall not supply, furnish, or install any pipe flanges, fittings, bolts, or nuts of foreign manufacture. All pipe flanges, fittings, bolts, and nuts shall be manufactured in the United States of America, and Contractor shall warrant the U.S.A. origin of all such items. Pipe flanges and fittings shall bear a stamp attesting to their place of origin. Contractor shall provide written certification from the manufacturer as to the origin of all flanges, fittings, bolts, and nuts installed on the Project.~~

PART 2 - PRODUCTS - NOT APPLICABLE

PART 3 - EXECUTION

3.1 INSTALLATION

A. Receive, unload, check, and store in suitable facilities all Equipment and Materials.

B. Examine all Equipment and Materials for concealed damage and report any damage to Owner.

C. Be responsible for the safety and protection from loss or damage of all Equipment and Materials received until the Work is complete.

D. Pay all demurrage charges and claims for damage to vehicles resulting from the unloading operation.

E. Protect all Equipment and Materials during storage and prior to start-up which shall include the coverings of all openings, protection against rust and other damage, and other similar measures. Equipment may be stored outdoors only when approved.

F. Furnish all labor, Materials, and Equipment necessary to make a complete installation as indicated and specified.

G. Provide all necessary supports, brackets, or foundations for properly installing all Equipment or temporary piping.

H. Coordinate with the other trades before installation of Materials. Extra charges shall not be approved for interferences due to lack of coordination.

I. All Equipment shall be properly adjusted and lubricated before final acceptance.

J. Spot paint all Equipment where the shop paint has been damaged or flaked off.

K. Furnish all bolts, studs, nuts, and gaskets for makeup of all connections to the Equipment and replace all gaskets damaged during storage, inspection, cleaning, or placing into service.

L. Retighten all threaded and bolted connections after installation.

M. Contractor shall be responsible for all added expenses due to his choice of Equipment.

N. All Materials shall be installed at times necessary to avoid delays in construction.

O. Provide vents and drains at high and low points where indicated and as required elsewhere for satisfactory draining and venting of fuel systems.

P. All connections to valves 3 inches and larger shall be made with flanges unless indicated otherwise; all connections to Equipment shall be made with unions or flanges.

Q. Piping shown on the Drawings is partially diagrammatic and not necessarily the exact routing. Provide all necessary bends that may be required to avoid conflict and interferences. Bends required in addition to those indicated shall be submitted for approval prior to fabrication.

R. Provide sleeves and flashings for all piping penetrating walls and slabs. Provide all required openings in walls and slabs.

S. Installation shall equal or exceed the minimum requirements of the applicable codes and these Specifications; however, where local codes and ordinances are more stringent, they shall govern.

T. Verify all measurements and location of existing facilities and piping before commencing work.

U. Certain permanent and temporary piping and equipment systems shall be installed, inspected, tested, flushed, and placed into operation prior to complete installation of the Work.

V. Contractor shall provide all gaskets, companion flanges, bolting, weld caps, temporary blank- off plates, temporary piping systems, labor, materials, and accessories required to place these systems into operation.

3.2 WELDING QUALIFICATION AND APPROVAL:

A. Procedure: The Welding Procedure Specification (WPS) that is intended to be used on the job shall be submitted to Owner's Authorized Representative.

B. Submit certified copies of the Procedure Qualification Records (PQR) as evidence that the intended procedures have been qualified in accordance with the latest revisions of the following codes:

1. ASME B31.3 - Process Piping.

2. ASME Boiler and Pressure Vessel Code, Section I and Section IX.

C. Design for the conditions of this Contract. Be complete and specific, and where necessary, differentiate between shop and field welding.

D. Welder Performance Qualification (WPQ) Test Certificates:

1. Furnish welder performance qualification test certificates, made in strict compliance with the above codes.

2. Submit current qualification test records for each welder on the Project and keep record files current. Welder shall have been qualified to the WPS within the last six months.

3. Welder Performance Qualification test certificates shall be submitted to Owner's Authorized Representative before the welder shall be permitted to work on the Project.

4. Welders shall be certified for the type of pipe material welded.

5. Submit copies of the Welder Performance Qualification (WPQ) test certificates to Owner's Authorized Representative for review as specified for Submittals.

6. Welders and welding operators shall be qualified without the use of backing rings for all welding.

E. Submit WPS, PQR and WPQ on the forms contained within Appendix A of the ASME Boiler and Pressure Vessel Code, Section IX.

F. Stamp all welds with the welders or welding operators' identification number or symbol.

3.3 FIELD TESTS:

A. Testing:

1. Perform all tests as specified and required by the codes. Additional tests deemed necessary by Owner shall be performed to ensure proper operation and function of the Equipment furnished, and to certify that the furnished Equipment meets the

performance specified.

2. Perform tests before Work is concealed and only after notifying Owner that items are ready. All tests shall be witnessed by Owner or Owner's Representative.

3. Conduct tests in a safe and orderly manner with qualified trained personnel in accordance with safety codes and local ordinances.

4. Obtain all necessary approvals, acceptances, and permits.

5. Correct all deficiencies resulting from tests.

6. Tests and Checks of Piping Systems for Acceptance:

   a. Inspection, Testing, and Flushing shall be as specified in SECTION 33 52 53.

B. Removed fuel from existing or new fuel pipe, that is returned to the Owner, shall be tested by a third party for contamination before returning to Owner. If it is determined that the fuel is contaminated, the Contractor shall take the fuel to an Oil/Fuel Recycling Facility to be disposed of. As the fuel is offloaded, it shall be metered and a record of the fuel amount shall be given to the Contractor. Records shall be provided to the Owner.

END OF SECTION 33 52 43

SECTION 33 52 44 - IDENTIFICATION OF FUEL PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the identification of piping and equipment. All exposed piping within pits and vaults should be labeled.

1.3 ACTION SUBMITTALS

A. Submit as specified in SECTION 33 52 43.

B. Include, but not limited to, the following:

1. Catalog cuts.
2. Sample(s) representative of labels specified.

1.4 REFERENCE STANDARDS

A. American Petroleum Institute:

1. Recommended Practice 1637 - Using the API Color-Symbol System to Mark Equipment and Vehicles for Product Identification at Service Stations and Distribution Terminals.

B. American Society of Mechanical Engineers (ASME):

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

C. Energy Institute:

1. EI 1542 - Identification Markings for Dedicated Aviation Fuel Manufacturing and Distribution Facilities, Airport Storage and Mobile Fueling Equipment.

D. Federal Aviation Administration:

1. Advisory Circular 150/5230-4B - Aircraft Fuel Storage, Handling and Dispensing on Airports.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of identification devices of types and sizes required, and whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. Comply with listed Codes and Standards for lettering size, length of color field,

colors, and viewing angles of identification devices.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. W. H. Brady Company.
2. Seton Name Plate Corporation.
3. Gammon Technical Products.

B. Paint products shall be as specified in SECTION 33 52 46.

2.2 IDENTIFICATION OF PIPING

A. Materials: Pressure-sensitive type labels or paint/stencil as specified herein.

B. Sizing of Pipe Markers, Arrows:

1. Conform to ASME A13.1 as a minimum for legend letter size and length of color field based upon outside diameter of pipe or covering if applicable.
2. Size of arrows shall be coordinated with pipe marker and letter size and also be based upon outside diameter of pipe, or covering if applicable.

C. Color Coding:

1. Jet A piping:

a. Label in accordance with EI 1542 and FAA Advisory circular 150/5230-4B. Label or stencil flow direction on piping.

b. Provide pressure sensitive type labels, Gammon Technical Products GTP-2135-5 (JET-A) or equal.

2.3 IDENTIFICATION OF FUEL EQUIPMENT

A. Materials: Protective Coatings as specified in SECTION 33 52 46.

B. All fuel system valves shall be painted black.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean area of surface to receive label or other pressure-sensitive item free of oil, grease, dust, dirt, or other substances which would affect adhesion.

B. On painted surface, install label only after coating system is complete and dry.

3.2 LOCATIONS

A. Piping Labels:

1. Use proper label type suitable for exterior location as applicable.

2. Locate labels on piping near connections to equipment, adjacent to valves or fittings, and at intervals not to exceed 25 feet.
3. For piping with arrows, indicate direction of flow. Place arrows adjacent to or below labels, depending upon visibility. For dual-flow piping, indicate both directions.
4. Locate legends to be visible from normal line of vision above floor finish or grade level.
5. Replace labels which do not adhere properly.
6. Location of identification/labels shall be approved by Owner.

END OF SECTION 33 52 44

SECTION 33 52 45 - FUEL SYSTEM PIPE, CONNECTIONS, AND INSTALLATION

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 covers aircraft fueling system piping, fittings, welded and screwed connections, qualification procedures, welding procedures, materials, radiographing (and other nondestructive testing) requirements, and construction requirements.

B. Buried piping shall be of double wall construction with pipe and fittings as specified herein for "CARRIER PIPE" and “CONTAINMENT PIPE”. Piping in vaults, pits and tie-ins to existing shall be as specified for “CARRIER PIPE”

C. All materials, items, and components specified herein shall be suitable for use within an aviation jet fuel system with a maximum operating condition of 275 psig from 0 to 100ºF and a specific gravity of 0.81 ±0.05.

D. All end connections on piping and fittings to be welded shall be prepared for butt welding, without backing ring. Butt welding end preparation shall conform to ASME B16.25.

~~E. Contractor or any Subcontractor or Supplier shall not supply, furnish, or install any pipe flanges, fittings, bolts, or nuts of foreign manufacture. All pipe flanges, fittings, bolts, and nuts shall be manufactured in the United States of America and Contractor shall warrant the U.S.A. origin of all such items. Pipe flanges and fittings shall bear a stamp attesting to their place of origin. Contractor shall provide written certification from the manufacturer as to the origin of all flanges, fittings, bolts, and nuts installed on the Project.~~

1.3 REFERENCE STANDARDS

A. American Petroleum Institute (API):

1. Spec 5L - Line Pipe.

B. American Society of Mechanical Engineers (ASME):

1. B16.9 - Factory-Made Wrought Steel Buttwelding Fittings.
2. B16.11 - Forged Steel Fittings, Socket-Welding and Threaded.
3. B16.20 - Metallic Gaskets for Pipe Flanges - Ring-Joint, Spiral-Wound, and Jacketed.
4. B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges.

5. B16.25 - Buttwelding Ends.
6. B16.47 - Large Diameter Steel Flanges.
7. B16.5 - Pipe Flanges and Flanged Fittings.
8. B31.3 - Process Piping.

C. American Society for Testing and Materials (ASTM):

1. A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
2. A105 - Carbon Steel Forgings for Piping Applications.
3. A106 - Seamless Carbon Steel Pipe for High-Temperature Service.
4. A139 - Electric-Fusion (Arc) - Welded Steel Pipe (NPS 4 and Over).
5. A193 - Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
6. A194 - Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service.
7. A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
8. A269 - Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
9. D229 - Test Methods for Rigid Sheet and Plate Materials Used for Electrical Insulation.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Pipe, Fittings, and Accessories.
2. Gaskets.
3. Flange Insulation Assemblies.
4. Pipe Supports.
5. Pipe Seals.

1.5 QUALITY ASSURANCE

A. All pipe and piping materials shall be produced by a manufacturer acceptable to the Owner’s Authorized Representative.

B. The double-wall piping system including all fittings shall be a factory prefabricated system. The manufacturer shall have a minimum of 5 years of experience in the design and manufacturing of containment piping systems.

C. A complete stress analysis of the double-wall piping system shall be conducted by the

manufacturer. Allowable stresses shall be defined by ASME B31.3. Analysis shall assume fluid temperature of 65ºF to 95ºF. Provide written report of analysis and results to the Owner's Authorized Representative.

D. The containment piping system manufacturer shall provide on-site field supervision during critical periods of installation which includes, but is not limited to, the following:

1. Inspection upon unloading.
2. Inspection of initial trenching operations.
3. Closure of containment piping.
4. Testing.
5. Initial backfilling operations.

E. Upon completion of installation, the manufacturer shall provide a written certification that the containment piping system was installed in accordance with the manufacturer's specifications.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Double-Wall Pipe:
   a. Rovanco.
   b. Permapipe.
   c. Thermacor.
2. Flange Gaskets:
   a. Flexitallic.
   b. Garlock.
   c. Lamons.
   d. Klinger.
3. Flange Insulation Assembly:
   a. EnPro Industries, Inc. (GPT)
   b. Advance Products & Systems, Inc.
   c. Approved equal.
4. Pipe Supports:
   a. Anvil.
   b. Cooper B-Line.

c. Piping Technology & Products.

5. Pipe Sleeve Seal:
   a. EnPro Industries, Inc. (GPT)
   b. Approved equal.
6. Pipe Sleeve Insulators:
   a. Advance Products & Systems, Inc.
   b. EnPro Industries, Inc. (GPT)

2.2 FUEL CARRIER PIPING MATERIALS

A. Pipe shall be ASTM A53 Grade B, ASTM A106, Grade B or API 5L Grade B, seamless or electric resistance welded double random lengths to reduce the number of joints. Stamp all pipe and stencil/label coated pipe with specification and grade. Submerged arc welded pipe is not acceptable. Material certificates and mill test reports shall be provided for all piping.

B. Pipe 2 inches and smaller shall be seamless Schedule 80, pipe 2-1/2 inches through 10 inches shall be Schedule 40, and 12 inches or larger shall be 3/8- inch (0.375-inch) wall thickness.

C. All buried carrier piping shall have full penetration welded connections, except where indicated otherwise for connection to existing piping. Socket-weld connections shall be used for 2 inches and smaller pipe in pits and aboveground piping except for connections to threaded valves, unions, and other equipment. Threaded and flanged connections shall be prohibited on all buried piping.

D. Pipe or fittings in the fuel piping systems shall not be galvanized.

E. Mill Cleaning and Coating of Pipe
   1. All carrier pipe 2-1/2 inches and larger and fittings 6 inches and larger shall be internally epoxy lined at the mill as specified in SECTION 33 52 46.
   2. All single-wall carrier pipe and fittings and containment pipe and fittings shall be externally coated as specified in SECTION 33 52 46.
   3. Clean inside and outside of pipe and fittings by sand or grit blasting or pickling to remove all mill scale.
   4. Apply in the mill an approved rust preventive coating to the interior and exterior of pipe and fittings immediately after cleaning. Rust preventive shall be approved by Owner and applied as recommended by the manufacturer. Rust preventive coating may be deleted from the pipe interior if pipe is internally epoxy lined immediately after cleaning. Rust preventive coating may be deleted from the pipe exterior if the pipe is externally epoxy coated immediately after cleaning.

5. The ends of the pipe shall be capped at the factory using suitable galvanized metal or plastic caps, secured with a double wrap of 2 inch-wide pressure sensitive tape.

2.3 FITTINGS FOR WELDED CARRIER PIPE

A. Butt welding type carbon steel, ASTM A234 Grade WPB, ANSI B16.9 for sizes 2-1/2 inches and larger. Wall thicknesses shall match pipe.

B. Socket welding 3,000-pound forged steel, ASTM A105, conforming to ASME B16.9 and B16.11, for sizes 2 inches and smaller. Butt weld fittings in lieu of socket weld are acceptable.

C. Elbows shall be long radius unless noted and indicated otherwise.

D. Changes in direction of pipe of other than 45 degrees or 90 degrees shall be made as follows:

1. With long radius weld ells cut to the proper angle and shop beveled.

2. Or, at the option of Contractor, with long radius pipe bends. Pipe roundness shall be maintained to factory tolerance for straight pipe lengths. Submit Shop Drawings of all bends and bending procedures for approval by Owner's Authorized Representative.

3. Bends of 2 degrees or less may be miter joints.

E. Welded Branch Connections:

1. Welded branch connections shall be butt welding tees except as described herein and with Owner's Authorized Representative's approval.

2. Fabricated tees shall be insert-type weldolets, elbolets, or vessolets. Standard weldolets shall not be used for below ground application, unless the existing below ground piping is to be abandoned-in-place, demolished, or permanently closed. Fittings and connections shall provide a smooth and accessible surface suitable for 100% nondestructive examination of all welds.

3. Fabricated branch connections for aboveground piping or piping exposed in pits 2 inches and smaller shall be sockolets. Field-fabricated half couplings shall not be used.

2.4 JET FUEL CONTAINMENT PIPE

A. Containment pipe shall be ASTM A139, ~~10-gage~~0.25-inch wall thickness spiral welded steel.

B. Containment piping, including connections, shall be of full welded construction and shall be liquid tight. Piping shall be rated for 50 psig.

C. Containment pipe shall be externally coated as specified in 33 5246. No interior lining is required.

D. Containment piping shall be sized to contain the fuel carrier pipe with sufficient clearance for field assembly and thermal expansion/contraction.

E. Fuel carrier pipe shall be supported within the containment piping. Pipe supports / centering devices shall be fixed to prevent movement during transportation, installation, and operation. Pipe supports shall be constructed of a material that is compatible with the fuel carrier pipe and will provide a positive electrical ground from carrier pipe to containment pipe. Pipe supports shall allow liquid to drain to the containment low point drain.

F. Centering devices are to be designed by the double-wall piping manufacturer and provided as part of the prefabricated piping system. Centering devices are to be constructed to allow drainage and venting of the containment piping system.

G. Containment pipe connectors for field welding shall be of split-sleeve or overlap weld design. Connectors shall be designed to withstand all mechanical forces. Wall thickness shall be equal or greater than pipe material.

H. End seals consisting of steel plate shall be provided as indicated on the contract drawings. End seals shall be design to accommodate forces imposed by expansion of the carrier pipe.

I. At each end seal termination point in a vault or pit, provide a ¾-inch NPT connection for venting and a 1-inch NPT connection for draining the annular space. Provide plugs for connections not used.

2.5 FITTINGS FOR CONTAINMENT PIPE

A. Fittings for containment pipe shall be factory fabricated from ASTM A234 Grade B steel pipe fittings, A53 steel pipe bends mitered to required angle or manufacturer's standard containment pipe fabricated fittings design. Allow clearance for the fuel pipe inside as shown on the drawings. Provide spacers as required to support pipe in fitting.

B. Wall thickness shall match pipe.

C. Containment fittings shall be all welded construction.

D. External coating for fittings shall be as specified in Section 33 52 46 for field applied external coating.

2.6 FITTINGS FOR THREADED FUEL PIPE

A. 3,000-pound forged steel conforming to ASME B16.11.

B. Threads of threaded jointed piping shall be full, clean, sharp, and true.

C. Bushings shall not be used except as noted and indicated on the Drawings.

D. Threaded fittings shall not be used except where noted.

2.7 FLANGES AND GASKETS

A. Flanges shall be standard weldneck type 150-pound forged steel, ASTM A105, and conforming to ASME B16.5, except where 300-pound, 600-pound, or ASME B16.47 Series B flanges are required to correspond to the equipment to which the piping is joined. ASME B16.47 Series A flanges are acceptable for companion pipe flanges above 24-inch size. Inside diameter of flanges shall be bored to match the inside diameter of the mating piping. Slip-on flanges conforming to the above standards shall

be provided where noted and indicated on the Drawings.

B. Flange facings shall correspond to the equipment to which the piping is joined, and unless otherwise required, shall be standard 1/16-inch raised face flanges.

C. Flange gaskets shall be "Flexitallic Type CG" using 304 stainless-steel windings with flexible graphite "fire rated" filler, or approved equal, conforming to ASME B16.20.

D. Gaskets shall be resistant to the effects of aviation hydro-carbon fuels and manufactured of fire-resistant materials.

E. Full face gaskets shall be used for flat face steel flanged joints. Full face gaskets shall conform to ASME B16.21, 1/8-inch thickness and be of fire-resistant composite material.

F. Ring gaskets shall be used for steel flanged joints with raised face flanges.

G. Gaskets shall be 1/8 inch in thickness and exceed the temperature and pressure rating of the flanges associate with the gaskets.

2.8 FLANGE BOLTS AND NUTS

A. Machine bolts shall be heavy hexagonal alloy carbon steel conforming to ASTM A193 Grade B7.

B. Nuts shall be heavy hexagon alloy carbon steel conforming to ASTM A194, Grade 2H.

C. Stud bolts may be used as required for corresponding equipment.

2.9 FLANGED INSULATING JOINTS AND FLANGE PROTECTORS

A. For insulating flange joint and flange protector specifications, refer to SECTION 13 47 13 CATHODIC PROTECTION SYSTEM.

2.10 PIPE SUPPORTS

A. Support design and location shall be as indicated. Refer to SECTION 33 52 43.

B. Provide complete assemblies adequately rated for the applied loads.

C. Install all required inserts and anchors prior to concrete placement.

D. Refer to Drawing for anchor bolt requirements.

E. Spacing and arrangements shall conform to ANSI B31.3.

F. Support locations are indicated on the Drawings for pipe sizes 2-1/2 inches and larger only, based on the pipe routing shown. Contractor shall locate and provide supports for piping smaller than 2-1/2 inches in accordance with specified Codes and Standards.

G. Contractors shall provide additional supports as required due to changes in the pipe routing or equipment supplied.

H. Reduce spacing one quarter where changes in direction occur.

I. Pipes run parallel in the same plane may be supported on gang supports.

J. Install to prevent sag or vibration and to adequately support the piping without interfering with inherent flexibility.

K. Make adjustments after systems are placed in operation.

L. Explosion or powder driven fasteners shall not be used.

2.11 WELDING FILLER MATERIALS

A. Welding filler material shall be provided in accordance with the applicable welding procedure specification.

B. Filler materials shall be compatible with the base metal and shall be specified and purchased by ASME BPVC Section IX or AWS classification and chemical composition.

C. Welding electrodes and filler materials shall be properly stored in suitable regulated temperature enclosures in accordance with manufacturer's recommendations. The use of wet or moist electrodes will not be permitted.

2.12 THREADED PIPE JOINT SEALING

A. Either of the two materials specified below may be used for sealing of threaded pipe joints unless otherwise specified. All threaded joints shall be sealed.

B. Screwed Pipe Joint Tape: TFE tape applied to male threads. Tape width, number of wraps, and use of additional paste sealant shall be in accordance with tape manufacturer's recommendations.

C. Screwed Pipe Joint Compound: Use compound which is resistant to the effects of aviation hydrocarbon fuels and Underwriters' Laboratories approved for the application intended.

2.13 PIPE SLEEVES

A. Provide sleeves for all pipes passing through equipment pads, slabs, valve vault walls, and other concrete or masonry structures.

B. Sleeve sizes through 10 inches shall be Schedule 40 steel pipe or standard wall thickness. Sleeve sizes 12 inches and larger shall have 0.375-inch wall thickness or standard wall thickness.

C. Provide an anchor collar/water stop of the same type of steel as the sleeve. The collar shall be welded all around on both sides to the sleeve at the point on the sleeve that positions at the mid point of the structural wall or pad when the sleeve is in place.

D. Sleeves shall be 2-inch nominal pipe size larger for pipes less than 4-inch nominal diameter and two pipe sizes larger for pipes 4-inch nominal diameter and larger. Coordinate sleeve dimension with sleeve seal specified herein.

E. Sleeves through walls shall be cast in place. Sleeves through pads shall be cast in place. Piping shall be installed centered in sleeve.

F. Sleeves shall be hot-dip galvanized. Where split sleeves are installed around existing pipes, sleeves shall be joined with full penetration welds. See structural design documents for required repair of galvanization removed to complete welding of split

sleeves.

2.14 PIPE SLEEVE SEAL (SEGMENTED SEALING ELEMENTS)

A. EnPro Industries, Inc. (GPT) "Link-Seal" 400 Series, Model "O", nitrile (Buna-N) sealing elements.

B. Use one seal at each end of the sleeve through walls and pads to keep the pipe in proper alignment.

2.15 PIPE SLEEVE INSULATORS

A. Insulator shall be a segmented collar molded of high density polyethylene with runners.

B. Shoe height of runners shall be as required to center the pipeline in the sleeve.

C. Insulator shall be bolted around the fuel pipe without damaging the pipe coating.

D. Sleeve insulator shall provide dielectric insulation between carrier and casing pipes.

2.16 PLIDCO WELD-PLUS-END COUPLINGS

A. Couplings shall be suitable for use with jet aircraft fuel (kerosene) and a maximum working pressure of not less than 275 psi at 100ºF.

B. Full couplings shall have single row of clamping screws the thrust screws at each end.

C. Packing shall be Viton.

D. Install and torque all screws in accordance with manufacturer’s instructions.

E. After coupling is put in service, clamping and thrust screws shall be cut off and seal-welded and ends fillet welded to pipe with pipeline full of fuel and in operation in strict accordance with manufacturer’s instructions.

F. Couplings shall be Plidco Weld-Plus-Ends (Weld+Ends), manufactured by Pipe Line Development Company.

2.17 PIPE BEDDING MATERIAL

A. Pipe bedding material shall consist of clean, dry, washed sand conforming to ASTM C144 or ASTM C33 with not more than 5% by weight passing the No. 200 sieve. Pipe bedding material shall have a neutral pH.

B. Sieve Analysis:

Sieve	ASTM C33 Percent Passing	ASTM C144 Percent Passing
3/8-in.	100	---
No. 4	95 to 100	100
No. 8	80 to 100	95 to 100

No. 16	50 to 85	70 to 100
No. 30	25 to 60	40 to 75
No. 50	10 to 30	10 to 35
No. 100	2 to 10	2 to 15
No. 200	---	0 to 5

PART 3 - EXECUTION

3.1 HAULING AND STRINGING PIPE

A. Perform the hauling and stringing of pipe and other materials in such a manner as to prevent damage to pipe and material. If damage is sustained, Contractor shall be responsible for repair or replacement cost.

B. Galvanized metal or plastic caps covering the ends of the pipe shall remain in place until the welding of the pipe. If any caps are not in place, resecure to the pipe ends to prevent dirt, water, and other foreign material from entering.

C. String pipe on right-of-way in such a manner as to cause the least interference with the normal use of the land crossed. Leave gaps at intervals to permit use of land and passage of equipment.

D. Contractor shall promptly repair, at his own expense, all roads, fences, building, or other property damaged by him in the progress of the Work.

3.2 LAYING UNDERGROUND PIPE

A. Pipe Trench excavation, backfill, and compaction shall conform to P-152 (Excavation and Embankment) of the Specifications.

B. Lay, embed, and maintain all underground pipelines to the flow-line elevation and grades shown on the Drawings.

C. The full length of each section of pipe shall rest solidly upon the pipe bed of compacted sand with depth as indicated. Sand bags or blocking shall be removed prior to final pipe bedding backfill.

D. Any pipe that has the grade or joint disturbed after being laid shall be taken up and relaid.

E. Do not lay pipe in water or when trench conditions are unsuitable except by written permission of Owner.

F. Anchor pipe during installation to prevent flotation prior to placement in service.

G. When Work is not in progress, securely close open ends (watertight) of pipe or fittings so that no trench water, earth, or other substance will enter the pipe or fittings.

H. Contractor shall be responsible for maintaining the cleanliness of the piping interior. Water, dirt, or foreign material shall be removed from the piping interior at no additional cost to the Owner.

I. Install pipe so as to be clear of contacts with other pipes, pipe sleeves, casings, reinforcing steel, conduits, cables, or other metallic structures.

J. Where coated fuel pipes cross other pipes, conduits or metallic or structures with a separation of less than 6 inches, install an insulating separator.

K. For utilities without cathodic protection, insulating separators shall be 12-inch by 12-inch by 1/2-inch thick UHMW polyethylene sheets. For utilities with cathodic protection, insulating separators shall be 36-inch by 36-inch by 1/2-inch thick UHMW polyethylene sheets.

3.2 INSTALLATION OF ABOVEGROUND PIPE

A. Install complete with valves, fittings, and accessories and make all necessary connections.

B. Provide offsets, fittings, and accessories required to eliminate interferences and to match actual equipment connection locations and arrangements.

C. All fabrication and installation shall conform to ASME B31.3.

D. Verify all measurements, and location of existing facilities and underground piping, before commencing Work. Submit discrepancies for clarification before proceeding with the installations.

E. Arrange all piping with proper slopes, true to line, without sags, traps, or pockets, and pitched to drain at the lowest points so that entire systems can be emptied.

F. Provide high point vents, pump outs, and low point drains as required or indicated on the Drawings.

G. Provide threaded unions where indicated and as required elsewhere to permit satisfactory disassembly of small bore piping for threaded valve and equipment maintenance.

3.3 HANDLING COATED PIPE

A. Storage Racks

1. Storage rack material shall be 4 to 6 inches in bearing width and placed not less than 10 feet apart.

2. Do not rack pipe 10 inches in diameter and larger more than two sections in height; and pipe 8 inches and under not more than 4 sections in height.

3. Protect all racked pipe by use of suitable padded material between sections.

4. All coated pipe shall be protected from ultraviolet deterioration.

B. Handling Operation

1. All trucks handling coated pipe shall have properly padded bolsters, chains, and binders so as to not damage the coating.

2. Pipe shall not be rolled off the truck but shall be carefully lowered onto the skids by mechanical equipment.
3. Coated and wrapped sections of pipe must be lifted with slings of approved width and are not to be dragged or pulled into position.

3.4 PIPE CLEANING

A. Clean each joint before welding into the system, to remove all loose debris.

B. Remove materials such as welding rods, dirt, and similar materials, left inside after completion of the lines. Expense incurred by Owner for removal of such objects shall be reimbursed by Contractor.

3.5 GAS FREE CONDITIONS

A. All operations in the construction area that involve open flames or the possibility of arcing or sparking shall be conducted in a "Gas Free" condition.

B. These operations shall include but not be limited to the following:

1. Use of internal combustion engines not equipped with Underwriters' approved spark and flame eliminators.
2. Use of electric motors or electric devices with arcing brushes or sliding contacts that could produce arcing or sparking.
3. Use of tools which may produce impact sparks.
4. Electric or gas welding.
5. Use of cutting or other torches or other open flame equipment.
6. Holiday testing.
7. Use of equipment with hot surfaces or glowing elements.
8. Use of any other equipment or procedure that could create a fire hazard.

C. Contractor shall monitor the use and suitability of the equipment and procedures on the job and maintain a safe "Gas Free" condition when necessary during construction.

D. Prior to commencing any phase of the Work requiring a gas free condition, Contractor shall make the following provisions:

1. Empty pipes containing fuel and purge of all vapors.
2. Isolate, blank off, and adequately ventilate open piping sections so that no part of the pipe containing fuel or vapors is exposed.
3. Make certain that there are no open pools or reservoirs of fuel exposed in the vicinity of the Work.
4. Perform all other safety precautions necessary to ensure that these operations are conducted in a safe manner in accordance with all applicable codes.

E. Use a combustible gas analyzer to make certain no combustible gas concentrations exist in the construction area when performing these operations.

3.6 CONNECTION TO EXISTING PIPE

A. The Contractor shall connect to the existing fuel pipes at the location shown on the drawings. Existing jet fuel lines are pressurized with jet fuel. Take necessary precautions before performing work on existing pipe lines.

B. Connections shall include modifying portions of the fuel pipes to allow the new fuel pipe adequate clearance to cross the existing fuel pipes.

C. Exercise extreme caution on active jet fuel pipes. This work shall include draining, purging, cutting, lowering, welding, testing, flushing, coating repairs, restoration and all incidental work to connect to the fuel pipe. Cleaning, testing, and flushing of pipe shall be in accordance with SECTION 33 52 53. Provide gas free conditions.

D. Each pipe shall be taken out-of-services only as directed by the Owner's Authorized Representative. Only one pipe may be out-of-service at a time. An out-of-service pipe must be returned to service before work on the next pipe can begin. Provisions shall be made to provide fuel with the remaining pipes in service.

E. All work on existing fuel pipes must be coordinated with GOAA and the fuel facility operator.

F. Contractor shall provide complete construction procedure and shop drawings of this work to Owner's Authorized Representative for approval.

G. Connection to existing pipe includes draining and refilling pipe to be placed back in service.

3.7 DRAINING AND REMOVING FUEL FOR CONNECTION TO EXISTING PIPING

A. The Contractor shall submit in writing a request at least 25 days prior to scheduling his work and shall have the approval of the Owner's Authorized Representative as to the time and date for isolating any fuel line to be drained. Work shall be completed within the time frame specified. Arrangements shall be made for the appropriate fire protection measures to be present during any of the fuel handling procedure. Any requirements to work hours other than what might be considered normal working hours (0800-1700) shall be done without any increase to contract cost.

B. The Contractor shall have at hand a clean, uncontaminated tank truck for collecting the fuel and shall arrange with the fuel facility operator the return of fuel to storage at the tank farm. The Contractor shall also provide fuel quality testing of fuel to be returned to storage. The Contractor will dispose of fuel not meeting test criteria.

C. The Contractor shall locate and identify the proper isolation valves associated with the fuel line to be drained.

D. If the pipe section to be drained does not have a low point drain, the Contractor shall provide for the installation of a temporary drain connection, to be removed upon completion of the work.

E. The Contractor shall be responsible for preventing fuel spills, and damage to the piping system and shall make good, at his expense, cleanup of any spill or repair to the fuel system.

F. All systems that have been out-of-service shall be flushed in accordance with SECTION 33 52 53 prior to returning to service.

3.8 WELDED JOINTS

A. Process: Welding shall be accomplished by the use of the shielded metallic arc (SMAW) process or gas tungsten arc welding (GTAW) or combination of both processes and shall be in strict accordance with ASME B31.3.

B. The minimum space between pipe welds shall be not less than 3 inches.

C. Procedure: Upon award of the Contract, submit for review current certified copies of the welding procedure specification (WPS), the procedure test record (WTR) and the welder qualifications test record (WQTR) that are intended to be used on the job in accordance with SECTION 33 52 43.

1. Welding procedure shall be designed for the conditions of this Contract and shall be complete and specific, and shall differentiate between shop, field welding, manual and automatic welding.

2. The Contractor shall provide the services of a testing laboratory, approved by the Owner's Authorized Representative, to certify each manual welder and welding machine operator for this Contract. Welds shall be made and tested as required by ASME B31.3 and Section IX of the ASME Boiler Code. The following conditions shall apply for qualification testing of each welder.

   a. All welds shall be made in the flat, horizontal, vertical-downhill or overhead position.
   b. All pipe groove weld test assemblies shall be welded in 6G test position. If welding is going to be done outside or in an enclosed shop then the welder performance test shall also be done outside in an enclosed shop. Wind screens or welding tents, if used, can be added for outside welding to minimize the effect of wind on arc shielding. No backing rings shall be used.
   c. All test welds shall be given a radiographic examination prior to the performance of bend test. Orientation shall be clearly marked on the image so that top dead center and bottom dead center is known when reading the film.
   d. All test welds shall be given the required guided bend tests as well as the radiographic examination
   e. Welders failing to qualify after (2) unsuccessful attempts shall not be retested and shall not be permitted to perform any welds on this project.
   f. All test results shall be submitted to the Owner's Authorized Representative for approval.

D. Costs: Costs incident to these procedures and the welder's qualification tests shall be assumed by Contractor.

E. Inspectors: Shop welding and fabrication shall be subject to the right of Owner to maintain one or more inspectors in the shop or to visit the shop at any time this Work is in progress.

F. Identification:

1. Each welder shall identify his weld with specific code marking signifying his name and assigned number.
2. Contractor shall maintain a code listing assigned to each welder.
3. Stamp on the pipe using "low stress" steel stamp, or other approved method, not closer than 4 inches to a weld.

G. Butt Welding End Preparation on all Pipe:

1. Conform to ASME B16.25 and B31.3.
2. Shop and field bevels shall be machine cut; manual flame cutting without machine guide shall not be permitted.
3. Remove internal masking applied at pipe ends for internal coating.

H. All underground carrier pipe welds shall have complete joint penetration and fusion and shall conform to ASME B31.3, except as specified in ARTICLES 3.10 and 3.11. Root pass and second pass shall be performed using GTAW process.

I. Backing rings shall not be used.

J. Align pipe joints with pipe clamps prior to welding as specified in WPS. Clamps or other alignment devices shall not reduce the internal pipe diameter. Misalignment shall be held within the limits stated in the WPS. Correcting for misalignment shall be done as shown in Figure 328.4.3 (a) or (b) of ASME B 31.3.

K. Defective welds shall be repaired in accordance with ASME B31.3 at Contractor's expense.

L. Repairs to defective welds shall not be made prior to authorization. Owner will determine on the basis of the testing laboratory report if repairs may be made or if the entire joint must be cut out and welded again.

M. No weld metal shall project within the piping at completion of the welding.

3.9 RADIOGRAPHIC EXAMINATION

A. Contractor shall coordinate and arrange for radiography by an approved testing laboratory of all welds on 100% of the underground carrier pipe or inaccessible fuel lines, and also a minimum of 10% of selected aboveground or exposed welded joints. This shall include all circumferential butt welds and all fabricated branch connections.

B. Testing laboratory shall be selected by and employed by Contractor subject to Owner's approval.

C. The radiographing shall be coordinated by Contractor and conducted at the Project Site such that Owner and the testing laboratory are provided with adequate notice that welds are available for radiographing and all the work required of Contractor in connection with the radiographing is properly completed at no additional cost to Owner. Factory welds of the final carrier pipe shall be radiographed by an approved testing laboratory. Radiography of factory welds may be conducted at the factory

site.

D. Reports for both factory and field welds shall be submitted throughout the progress of the Work as described below.

E. All radiographing and subsequent reports shall be in accordance with the requirements of ASME B31.3.

F. Each weld shall be assigned a number. Contractor shall maintain a marked up copy of piping drawings identifying the location and number of each radiographed weld. Upon completion of the Work, these drawings shall be submitted with as constructed drawings.

G. Radiograph exposure records shall be kept by the testing laboratory which show date, location, area, film number, serial number, film combination, time, source-film distance, angulation, weld number and other pertinent information for each weld radiographed.

H. A summary of this record and an expert interpretation by the testing laboratory shall be submitted in report form for each weld to Owner, Owner's Authorized Representative, and Contractor.

I. All joints shall be left exposed until radiographing and other testing is completed.

J. Welds which do not meet the standards of acceptability as outlined in the above mentioned ASME B31.3, will be judged unacceptable and shall be repaired or cut out and rewelded by Contractor as directed by the testing laboratory, all at no additional cost to Owner. Repaired and rewelded joints will then be reradiographed.

K. Inspection stamps, code symbol stamps, and other required information shall be stamped on the pipe by using "low stress" steel stamps, or other approved method.

L. All the costs of the radiographing at each weld and the accompanying reports and interpretation shall be paid by Contractor and shall be included in the Contract Price. Contractor shall be responsible for coordination and scheduling of the Work.

3.10 MAGNETIC PARTICLE AND DYE PENETRANT TESTING

A. Contractor shall coordinate and arrange for dye penetrant or magnetic particle testing of all containment pipe welds by an approved testing laboratory of all new buried welds on Plidco fittings.

B. The dye penetrant or magnetic particle tests shall be conducted on the entire 360-degree circumference of each Plidco connection to existing system piping.

C. Testing laboratory shall be selected by and employed by Contractor subject to Owner's Authorized Representative's approval.

D. The dye penetrant or magnetic particle testing of containment pipe welds at shop and field connections shall be coordinated by Contractor and conducted at the Project Site such that the Owner and the testing laboratory are provided with adequate notice that welds are available for testing and all the Work required of Contractor in connection with the testing is properly completed at no additional cost to Owner.

E. Reports for field welds shall be submitted throughout the progress of the Work as described below.

F. All dye penetrant or magnetic particle testing and subsequent reports will be in accordance with the requirements of ASME B31.3 and Section V of the ASME Boiler and Pressure Vessel Code.

G. Each weld shall be assigned a number. Contractor shall maintain a marked up copy of piping drawings identifying the location and number of each weld. Upon completion of the Work, these drawings shall be submitted with as built drawings.

H. Dye penetrant or magnetic particle testing records shall be kept by the testing laboratory which show date, location, area, weld number, and other pertinent information for each weld tested.

I. A summary of this record, and an expert interpretation by the testing laboratory shall be submitted in report form for each weld to Owner, Owner's Authorized Representative, and Contractor.

J. All fittings shall be left exposed until testing is completed.

K. Welds which do not meet the standards of acceptability as outlined in the above mentioned ASME B31.3 will be judged unacceptable and shall be repaired or cut out and re-welded by Contractor as directed by the testing laboratory, all at no additional cost to Owner. Repaired and re-welded joints will then be retested.

L. Inspection stamps, code symbol stamps, and other required information shall be stamped on the pipe by using "low stress" steel stamps, or other approved method.

M. All the costs of the testing at each weld and the accompanying reports and interpretation shall be paid by Contractor and shall be included in the Contract Price. Contractor shall be responsible for coordination and scheduling of the testing work.

3.11 TESTING OF PLIDCO COUPLINGS

A. The circumferential welds, and all but two clamping bolt seal welds shall be pneumatically tested as follows.

B. Fabricate two test plugs, consisting of a center-drilled and tapped bolt suitable for connection to pressure testing apparatus. Insert the plugs in the top two clamping bolt holes on the Plidco coupling (one on each coupling end).

C. Pressurize the fuel line to normal system operating pressure with fuel.

D. Using the ports connected to the test plugs, apply compressed nitrogen or air to the interior of the Plidco coupling. Apply pressure until the indicated pressure is equal to fuel system operating pressure.

E. Soap all welds (circumferential, thrust bolt, and clamping bolt seal welds) and observe for signs of leakage.

F. Repair any defective welds and retest.

G. Once pneumatic testing has been successfully completed, remove test plugs and replace with original standard clamping bolts. Cut off and seal weld these bolts as

done for other bolts.

H. Perform non-destructive testing of the circumferential welds and all seal welds performed on thrust bolts and clamping bolts as specified in this Section. Seal welds shall be ground smooth as required to permit testing.

I. Repair any welds found to be defective, and retest.

END OF SECTION 33 52 45

SECTION 33 52 46 - LIQUID FUELS PIPELINE COATING SYSTEMS

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 covers the field and shop-applied corrosion protection coatings of exterior and interior surfaces for fuel system piping, pipe supports, valves, fittings, equipment, structural steel, and all materials to be located underground.

B. Coating includes surface preparation, prime coat (first coat), finish coats (second and third coats), inspection, cleaning, and touch-up of surfaces and equipment. Shop preparation, prime coat and finish coats to be shop applied, may be specified elsewhere or referenced to this Section so that a complete system is specified and coordinated.

1. Where surface preparation and first (prime) coat are specified in other sections to be shop applied such as for structural steel, or equipment, only the touch-up and finish coats are a part of field painting. Surface preparation is the required degree of preparation prior to application of first (prime) coat.
2. If materials are provided without shop primer such as miscellaneous steel or sheet metal, then surface preparation, first, second, and third coats are a part of field painting.
3. Where equipment or materials are provided with shop-applied finished coating system, only touch-up is a part of field painting.
4. Refer to applicable sections to determine whether surface preparation and first coat, or complete coating system, is to be shop applied.

C. See Specification SECTION 33 52 45 for special safety requirements for a "gas-free" condition during certain operations in the construction area.

D. Colors:

1. Colors shall be selected after submittal of approved manufacturer's color Samples.
2. Color of finish coatings shall match accepted color Samples.
3. When second and finish coats are of same type, tint or use an alternate color on second coat to enable visual coverage inspection of the third coat.

1.3 REFERENCE STANDARDS

A. The work shall be performed in accordance with the latest requirements of laws and codes governing this work, including but not limited to:

1. Society for Protective Coatings (SSPC):

a. SP 1 - Solvent Cleaning. Removes oil, grease, soil, and other substances. Used with other methods to remove rust, paint, and mill scale.

b. SP 3 - Power Tool Cleaning. Removes loose material. Not intended to remove all scale or rust.

c. SP 5 - White Metal Blast Cleaning. Removes all scale, rust, foreign matter. Leaves surface gray-white uniform metallic color.

d. SP 6 - Commercial Blast Cleaning. Two-thirds of every 9 square inches free of all visible residues; remainder only light discoloration.

e. SP 7 - Brush-Off Blast Cleaning. Removes only loose material, remaining surface tight and abraded to give anchor pattern.

f. SP 10 - Near-White Blast Cleaning. At least 95% of every 9 square inches shall be free of all visible residues.

g. SP 11 - Power Tool Cleaning to Bare Metal.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Schedule of products to be used. Schedule shall include the following information:

a. Surfaces for system to be applied.

b. Surface preparation method and degree of cleanliness.

c. Product manufacturer, name, and number.

d. Method of application.

e. Dry film mil thickness per coat of coating to be applied.

f. Color charts for selection and acceptance.

B. Technical and material safety data sheets.

1.5 QUALITY ASSURANCE:

A. Include on label of container:

1. Manufacturer's name, product name, and number.

2. Type of paint and generic name.

3. Color name and number.

4. Storage and temperature limits.

5. Mixing and application instructions, including requirements for precautions which must be taken.

6. Drying or curing time.

B. Factory-Applied Pipe Coatings:

1. Coating applicator shall have a minimum of 5 years of certifiable experience in the type of coating work required.

2. Certification of quality control procedures during application of internal and external coatings shall be submitted to Owner's Authorized Representative for review. Certification to include: Surface preparation, film thickness per coat, curing procedures, and holiday testing.

C. Pre-Painting Conference:

1. Within 90 days after Contract award and before Project field painting starts, representatives for Owner, Contractor, coating contractor, and coating manufacturer's technical representative shall meet with Owner's Authorized Representative.

2. Agenda for the meeting will include details of coating specifications to ensure understanding and agreement by all parties for compliance.

D. Coating contractor shall certify in writing to Owner's Authorized Representative that he has previously applied all the systems in this Specification and has the ability to prepare the surfaces correctly as specified.

1. A coating report shall be completed daily at each phase of the coating system starting with surface preparation. These will be submitted on the form attached at end of this Section.

E. In the event a problem occurs with coating system, surface preparation, or application, coating contractor and coating manufacturer's technical representative shall promptly investigate the problem and submit results to Owner's Authorized Representative.

F. Stated VOC shall be unthinned maximum VOC certified by manufacturer. Maximum VOC allowable in this area shall be verified and complied with by coating contractor.

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Delivery of Materials:

1. Deliver in sealed containers with labels and information legible and intact.

2. Allow sufficient time for testing if required.

B. Storage of Materials:

1. Store only acceptable materials on Project Site.

2. Provide separate area and suitable containers for storage of coatings and

related equipment.

3. Dispose of used or leftover containers, thinners, rags, brushes, rollers, and related materials in accordance with applicable regulations.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Proprietary names and product numbers are specified in most protective coating system data sheets for material identification.

B. Subject to compliance with specified requirements, provide products from the listed manufacturers.

1. Carboline Company, Inc.
2. Sherwin-Williams.
3. International.
4. Tnemec Company, Inc.
5. Valspar.
6. Devoe - AkzoNobel.
7. Polyken Pipeline Coatings.
8. Tapecoat Company.
9. Denso North America.
10. 3M Electrical Specialties Division.
11. PPG.

2.2 GENERAL

A. Materials furnished for each protective coating system shall be compatible to the substrate.

B. When unprimed surfaces are to be coated, entire coating system shall be by the same coating manufacturer to assure compatibility of coatings.

C. When shop-painted surfaces are to be coated, ascertain whether finish materials will be compatible with shop coating. Inform Owner's Authorized Representative of any unsuitable substrate or coating conditions or product.

D. Internal pipe coating shall be certified by the manufacturer to be suitable for exposure to Jet A fuel.

2.3 SURFACES AND MATERIALS TO BE COATED

A. Shop-applied internal epoxy lining for carrier pipe and fittings

1. Surfaces to be coated: Internal epoxy coating of fuel piping and fittings 2-1/2 inches and larger.
2. Surface Preparation: SSPC-SP10 with nominal profile depth of 1.5 to 2.5 mils (38 to 63 microns).

3. First Coat: High solids, high build, amine-cured epoxy, 55% solids by volume, off- white or similar color. Apply at 5 to 6 mils (125 to 150) dry film thickness. 2" (50 mm) cutback at pipe ends.
4. Second Coat: Same as first coat, except white color. 2" (50 mm) cutback at pipe ends.
5. System Total: Minimum 10 mils (250 microns) dry film thickness.
6. Volatile Organic Content: Per local regulatory requirements.
7. Inspection: Check for voids with suitable electric holiday detector operating at proper voltage.
8. Approved Products:
    a. Amercoat 240
    b. Devran 744
    c. Interline 850
    d. Tneme-Liner Series 61

B. Shop-applied external protective pipe coating for containment pipe and fittings and any buried carrier pipe and fittings.
1. Surfaces to be coated: Exterior of secondary containment pipes and fittings and buried carrier pipe and fittings to be coated with Fusion Bonded Epoxy (FBE).
2. Surface Preparation: Grit blast to SSPC-SP10, with minimum profile depth of 2.5 mils (0.064 mm). Surface shall be clean and dry.
3. Field: Grit blast uncoated or damaged coated area to SSPC-SP6. Surface shall be clean and dry.
4. First Coat: Shop applied, fusion bonded epoxy powder. Apply at 20 mils (0.508 mm) minimum dry film thickness. 2" (50 mm) cutback, or wipeback at pipe ends.
5. Second Coat: Field applied, two component catalyzed epoxy specifically for use with specified first coat and of same color.
6. System Total: 20 mils (0.508 mm) dry film thickness.
7. Inspection: Check for voids with suitable electric holiday detector operating at proper voltage. Touch up as recommended by manufacturer.
8. Approved Products:
    a. Valspar PipeClad
    b. 3M Scotchkote 206N
    c. NapGuard 7-2500

C. Field-applied external protective coatings
1. Surfaces to be coated: Underground fittings, field welds, and other large repairs of exterior of buried piping systems.
2. Surface Preparation: Clean free of dirt, mil lacquer, wax, oil, grease, rust, mill

scale, or other foreign material, in accordance with SSPC-SP2 or SSPC-SP3.

3. First Coat: Field applied high-solids, fast-drying, surface tolerant epoxy coating. Minimum 87% solids by volume. Apply at 10 mils dry film thickness.
4. Second Coat: Same as first coat.
5. System Total: 20 mils (0.508 mm) dry film thickness.
6. Field Inspection/Repair: Check for voids with suitable electric holiday detector operating at proper voltage.
7. Approved Products:
    a. TC 7100 Wet Bond Epoxy
    b. Protal ST Epoxy Mastic

D. Field-applied external coatings where interfacing with existing coating systems
1. Apply pipe wrapping system to bare pipe and wrap interface between new and existing coating system. Overlap new tape wrap over existing and new coatings a minimum of 6 inches each.
2. Surface Preparation: Clean free of dirt, mil lacquer, wax, oil, grease, rust, mill scale, or other foreign material.
3. First Coat: Apply primer in a uniform thin film, free of runs, sags, and drips.
4. Second Coat: Apply 35 mil polyethylene tape of proper width for pipe size. Clean same as above, apply primer, and polyethylene joint wrap tape in a spiral fashion with 50% overlap. End joint wrap with final edge directed downward. Tape temperature shall be minimum of 40^{o} F. Overlap end splices 6".
5. Field Inspection/Repair: Check for voids with suitable electric holiday detector operating at proper voltage.
6. Approved Products:
    a. Polyken Primer & Polken No 930-35 Wrap
    b. TC-MA 2000 Primer & TC-P-35 Joint Wrap

E. Coatings for pipes in underground pits and vaults.
1. Surfaces to be coated: Exterior of pipe, fittings, and valves in underground vaults or pits.
2. Surface Preparation: Shop: SSPC-SP6 and profile depth 1.5 to 2.5 mils (38 to 63 microns). Field: SSPC-SP6 or 11 and profile depth 1.0 mil (25 microns) minimum.
3. First Coat: High solids polyamine or polyamide epoxy coating with minimum 67% solids by volume. Apply at 5 to 8 mils (125 to 200 mm) dry film thickness.
4. Second Coat: Same as first coat - white color.
5. System Total: Minimum 10.0 mils (250 microns) dry film thickness.
6. Volatile Organic Content: Per local regulatory requirements.
7. Inspection: Check for voids with suitable electric holiday detector operating at proper voltage.

8. Approved Products
    a. Amerlock 2/400
    b. Carboline 890
    c. Interseal 670 HS
    d. Sherwin Williams Macropoxy 646 FC
    e. Epoxoline II Series N69

F. Coatings for aboveground piping
1. Surfaces to be coated: Aboveground exposed piping, valves, and other fuel equipment with corrodible surfaces (exterior). All fuel system valves shall be painted black.
2. Surface Preparation: Field First Coat: SSPC-SP6 1.5 to 2.5 mil profile (38 to 63 microns).
3. First Coat: High build, high solids polyamide, polyamine, or polyamidoamine epoxy with minimum 65% solids by volume. Apply at 4.0 to 6.0 mils (100 to 150 microns) dry film thickness.
4. Second Coat: High build, high solids polyurethane low sheen enamel with minimum 60% solids by volume. Apply at 4.0 to 5.0 mils (75 to 125 microns) dry film thickness.
5. System Total: Minimum 8.0 mils (0.229 mm) dry film thickness.
6. Volatile Organic Content: Maximum per local regulatory requirements.

G. Coating for Casing to be installed by Micro Tunneling
1. Surfaces to be coated: Buried Micro Tunneling Casing, extended to minimum 6 inches inside vaults.
2. Surface Preparation: SSPC-SP5/NACE 1/ISO Sa 3 White Metal Blast Cleaning with a minimum angular anchor profile of 3.0 mils (76.2 microns). All surfaces must be clean, dry and free of oil, grease and other contaminants.
3. First Coat: High build, high solids polyamidoamine epoxy with minimum 67% solids by volume. Apply at to 6.0 mils (150 microns) dry film thickness.
4. Second Coat: Series 431 must be applied to Series N69 or N140 within 7 days. Scarify the surface with fine abrasive before topcoating if exceeding this maximum recoat window.
5. System Total: Minimum 36 mils (914 microns) dry film thickness.
6. Volatile Organic Content: Maximum per local regulatory requirements.
7. Approved Products
    a. Tnemec Hi-Build Epoxoline II, Series N69 or Pota-Pox Plus Series N140 for First Coat.
    b. Tenemec Perma-Shield PL Series 431 for Second Coat.
    c. Approved equal.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. Prepare surfaces for each coating system conforming to SSPC or ASTM surface preparations specifications listed.

1. If grease or oils are present, SSPC-SP 1 shall precede any other method specified.
2. Remove surface irregularities such as weld spatter, burrs, or sharp edges, prior to specified surface preparation.
3. Prepare surfaces of field welds, sears, or other damage, and touch up with coating as specified or recommended by manufacturer.

B. Depth of profile will be as specified for each system, but in no instance shall it exceed one-third of the coating dry film thickness per coat.

C. Prepare only those areas which will receive the first coat of the system on the same day.

3.2 APPLICATION

A. Apply coatings in accordance with coating manufacturer's recommendations. Use properly designed brushes and spray equipment for all applications.

B. Coating for the casing pipe installed by means of microtunneling shall have a letter from the coating manufacturer certifying that the product is suitable for the intended application.

C. Any damage to protective coating shall be repaired per the manufacturer’s recommendations and proper cure times shall be adhered to prior to installing carrier pipes and casing pipes.

D. Dry film thickness of each system shall meet the minimum specified but not exceed it more than 20% or coating manufacturer's requirements if less.

E. On unprimed surfaces apply first coat of the system the same day as surface preparation.

F. Shop painting shall remain 3 inches away from unprepared surface of any substrate such as areas to be welded or bolted.

G. Environmental Conditions:

1. Atmospheric temperature must be 50ºF or higher during application, unless approved by coating manufacturer. Do not apply coatings when inclement weather or freezing temperature may occur within coating curing time requirements.
2. Wind velocities for exterior applications shall be at a minimum and not greater than coating manufacturer's limits.
3. Relative humidity must be less than 85% and the temperature of the surface

to be painted must be at least 5ºF above the dew point.

4. Provide adequate ventilation equipment in all areas of application to ensure that at no time does the content of air exceed the Threshold Limit Value given on the manufacturer's Material Safety Data Sheets for the specific coatings being applied.

H. Protection:

1. Cover or otherwise protect surfaces not being painted, areas not to be painted, and the work of other trades. Remove protective materials when appropriate.
2. Provide signs to indicate fresh paint areas.
3. Mask, remove, or otherwise protect finish hardware, machined surfaces, grilles, lighting fixtures, and prefinished units as necessary.
4. Provide cover to prevent paints from entering orifices in electrical or mechanical equipment.
5. Provide daily cleanup of both storage and working areas and removal of all paint refuse, trash, rags, thinners, and related materials. Dispose of leftover containers, thinners, rags, brushes, rollers, and related materials in accordance with applicable regulations.
6. Do not remove or paint over equipment data plates, code stamps on piping, or UL fire- rating labels.

3.3 CLEANING

A. Touch up and restore damaged finishes to original condition as required.

B. Remove spilled, dripped, or splattered paint from all surfaces.

3.4 COATING REPAIRS

A. Repair all damages to pipe coating systems before the piping is holiday tested.

B. This includes all cuts, breaks, voids, bruised or scarred spots, or other damage caused prior to delivery, or resulting from handling or installation of the pipe, or from any cause whatsoever.

C. Included also are damaged coatings where new connections are made to existing coated pipes or where existing coated pipes are uncovered or exposed for any reason.

D. Also repair the coating where welds are made and where damaged or broken by the installation of instrumentation or other accessories or appurtenances.

E. Repair all holidays detected during inspection of coatings.

F. Repair coating where field welds are made or where otherwise damaged.

1. Complete all weld radiography for fuel piping joints prior to application of coatings.

G. Inspection:

1. Use wet film gauges to check each application about every 15 minutes in order to correct low or heavy film build immediately.
2. Use dry film gauge to check each coat when dry, and the total system when completed.
3. Use holiday or pinhole detector on metal systems to detect and correct voids when indicated on system sheet.
4. Furnish a sling psychrometer and perform periodic checks on both relative humidity and temperature limits.
5. Check temperature of the substrate at regular intervals to be certain surface is 5ºF or more above the dew point.
6. Complete coating reports daily using form approved by the Owner's Authorized Representative.

END OF SECTION 33 52 46

SECTION 33 52 47 – FUEL SYSTEM VALVES AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section covers the aircraft fueling system valves, valve pits, and related appurtenances which are in contact with jet fuel.

B. All items, materials, and components specified herein shall be suitable for use within an aviation jet fuel system with a maximum operating condition of 275 psig, 0ºF to 100ºF, and having a specific gravity of 0.81.

1.3 REFERENCED STANDARDS

A. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

B. American Society for Testing and Materials (ASTM):

1. A216 – Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding for High-Temperature Service.

C. American Society of Mechanical Engineers (ASME):

1. B16.34 - Valves - Flanged, Threaded and Welding End.

D. American Petroleum Institute (API):

1. SPEC 6D - Specification for Pipeline and Piping Valves.
2. SPEC 6FA - Specification for Fire Test for Valves.
3. STD 607 - Fire Tests for Quarter-turn Valves and Valves Equipped with Nonmetallic Seats.

1.4 SUBMITTALS

A. Submit as specified in SECTION 33 52 43.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualification: Firms regularly engaged in manufacture of the valves or equipment of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Ball Valves:
   1. Worcester Controls.
   2. Bray/Flow-Tek.
   3. WKM.
   4. Watts.
   5. Jamesbury.
   6. Velan.
   7. Approved equal.

B. Butterfly Valves:
   1. Bray.
   2. Keystone.
   3. Dezurik.
   4. WKM.
   5. Cameron.
   6. Approved equal.

C. Double Block and Bleed (DBB) Plug Valves:
   1. General Twin Seal (Cameron).
   2. Dan-Ex (Western Valve).
   3. Approved equal.

D. Control Valves:
   1. Cla-Val

E. Hydrant Valve:

1. Eaton.

F. Hydrant Fuel Pit Assembly:

1. Cavotec Dabico, Inc.

G. Low-Point Drain Pit Assemblies:

1. Cavotec Dabico, Inc.

H. High-Point Vent Pit Assemblies:

1. Cavotec Dabico, Inc.

I. Vault Access Covers:

1. Cavotec Dabico, Inc.

J. Quick Disconnect Adapters:

1. OPW.
2. Approved equal.

K. Pressure Gauges:

1. Ashcroft (Model 1009).
2. Wika.
3. Approved equal.

L. Fueling Pump and Motor:

1. Ruhrpumpen & Western Electric.

M. Filter/Separators:

1. Facet.

2.2 BALL VALVES

A. Valve body shall be of carbon steel with 316 stainless steel ball and stem. Construction shall be in compliance with ASME B16.34.

B. Valve shall be rated for 275-psig working pressure.

C. Valves 1-1/2-inch size and smaller shall be of two-piece, end-entry construction, with socket weld end connections unless indicated or specified otherwise.

D. Valves in pits or vaults 2-inch size and larger shall be of two-piece split body construction, with flanged end connections unless indicated otherwise.

E. Seals and/or seats shall be reinforced TFE. Graphite stem seal to meet API-607 fire safe.

F. Provide with a vinyl-coated, stainless steel locking handle suitable for padlocking. Valves 6-inch size and larger shall be provided with a closed case gear operator.

G. Valves shall be certified "fire safe" per API-607.

H. Provide spring return actuator where shown.

2.3 BUTTERFLY VALVES

A. Valves shall be metal-lined, single-flanged type, drilled and tapped full lug body.

B. Valves shall be certified "fire safe" per API-607.

C. Valve shall be suitable for 275-psig working pressure, bubble-tight at differential pressure of 275 psig, and a maximum shutoff pressure of 300 psig.

D. Valve body shall be compatible to ANSI Class 150 with a face-to-face dimension or laying length in accordance with API-609.

E. The disc shall be "double offset" and shall be capable of bi-directional flow and shall be suitable for dead-end service in both directions.

F. Valve body shall be carbon steel, shaft material of stainless steel, disc shall be 316 stainless steel, with 316 stainless steel pins for attachment to the shaft. Valve shall have adjustable top packing for the shaft. Top of shaft shall be keyed to allow installation of operator at two positions 90 degrees apart. Valve seat shall be 316 stainless steel with TFE insert material.

G. Valves shall be suitable for installation between 150-pound raised-face flanges.

H. Operators shall be as follows:

1. Valve sizes 6 inches and smaller shall have a 10-position, spring-loaded, squeeze trigger handle with locking device.

2. Valve sizes 8 inches and larger shall have a weatherproof, self-locking, worm gear operator.

2.4 DOUBLE BLOCK AND BLEED (DBB) PLUG VALVES

A. Valve body shall be steel with reduced port configuration and chrome-plated bore. Valve plug shall be chrome or nickel plated. Valve port openings shall be approximately 70% free area of pipe size installed in.

B. The valve assembly shall include a manual bleed valve and a thermal relief valve discharging upstream of valve throat.

C. Slip seals and valve O-rings shall be Viton.

D. Valve shall be fire tested and qualified to API 6FA. Valve shall be rated for 275-psig working pressure.

E. Gear operators the provision for locking shall be provided for valves 6 inches and larger. Where shown provide extension to valve vault access cover.

F. Provide General Twin Seal Valve Model C8811 or approved equal.

2.5 CONTROL VALVE

A. Control valves shall be globe style, diaphragm type and design to be suitable for use in jet fuel at 100 degrees F at a pressure of 275 psig. Valves shall be manufactured by Cla-Val.

B. Valve size shall be as indicated on the Plans.

C. Valve body shall be domestic cast steel with ANSI Class 150-lb flanges.

D. Main valve trim, seats, guides, control pilots and tubing systems shall be stainless steel.

E. Valve elastomers shall be Viton in the control pilots and Buna-N in the main valve.

F. Valve shall be equipped with explosion proof solenoid, 120 volts, to close on loss of power from EFSO. Solenoid shall have manual override. Mount solenoids high in the valve vault to keep dry. Valve must fail in the closed position.

G. Valve shall be equipped with opening and closing speed control, pilot tubing strainers, pilot system shut offs, and magnetic proximity limit switch. Provide mounting bracket and valve stem extension and magnetic target, similar to Go switch model 72.

H. Valve body shall be electroless nickel plated inside and out or fusion bonded epoxy for all surfaces in contact with jet fuel.

I. Valve shall be fitted with check feature, solenoid shut off, pressure reducing, and pressure differential control.

J. Valves shall be designed for parallel flow; the smaller valve shall have a flow control orifice plate and piloting to limit the flow to 500 gpm (adjustable). Both valves shall be able to reduce inlet pressure of 275 psig to 90-140 psig outlet pressure (adjustable).

K. Include one set of spare O-rings for each size of control valve supplied. Provide stainless steel valve tag with valve size, model number and serial number.

2.6 HYDRANT VALVE

A. Valve shall be Eaton, Model-60654.

B. Valve shall be cast ductile-iron body, epoxy coated with 4 inch, 150-pound ANSI inlet flange. Outlet adapter shall conform to API Bulletin 1584, 3rd edition. Provide dust cap and retention chain.

C. Valve shall have an air-operated pilot valve, to open and close valve.

2.7 HYDRANT FUEL PIT ASSEMBLY

A. General Requirements: Assembly to be complete with shutoff valve, hydrant pit valve, strainer, and piping accessories to be installed in a concrete pavement apron, suitable for interfacing the fixed fuel system components with the hydrant fueling vehicle. Pit shall be on the Florida Department of Environmental Protection approved equipment list.

B. Performance: Designed to permit a fueling flow rate of 1,000 gpm. Liquid to be jet fuel with a specific gravity of 0.81 ±0.05.

C. Construction:

1. Pits shall be side entry.

2. Body shall be one-piece molded fiberglass, with built-in concrete anchors.

3. Pit shall have sealed interior pipe entry consisting of a pipe sleeve with anchor ring integrally molded into the fiberglass pit wall, and inner and outer sleeve

seals. Inner sleeve seal shall have a test port to provide testing capability of institutional space. Sleeve seals shall be Buna-N.

4. Cover: Cast aluminum double-hinged assembly, 30-pound, lay flat, one-hand lift weight, 90 degree minimum door opening, water resistant, removable.
5. Provide deep-dish hand hole in cover to permit opening by gloved hand.
6. Cover assembly to be tested at 1,000 psi over 200-square-inch footprint with a maximum acceptable full-load deflection of 0.100-inch, and cover deflection rebound data shall result in a maximum of 0.010-inch after a 740-psi test load has been applied and released. Covers must be free of visual shrink porosity cavity areas, weldments, filler, and paint. A previous independent certified testing laboratory report for the cover assembly shall accompany the Submittal data for the service pit. Weight-bearing flange surfaces of both the pit and cover shall be machined flat to a total indicator reading of ±0.010-inch for flatness to assure uniform weight distribution.
7. Entire cover assembly and pit as installed shall be capable of accommodating wheel loads of any aircraft in commercial service.
8. Product identification shall be in raised letters in the cover door. Identification shall be "FUEL."

2.8 HIGH-POINT VENT/LOW-POINT DRAIN PIT ASSEMBLIES

A. General Requirements: One-piece molded fiberglass pit assembly complete with valves and piping accessories. Pit shall be on the Florida Department of Environmental Protection approved equipment list.

B. Performance: Designed to incorporate low-point drain or high-point vent piping as detailed and as required to facilitate draining water or venting air and/or fuel from buried fuel piping.

C. Construction:

1. Pits shall be nominal 24-inch-diameter with 38-inch-deep skirt.
2. Body shall be one-piece molded fiberglass, with built-in concrete anchors.
3. Pit shall have a sealed interior pipe entry consisting of a pipe sleeve with anchor ring integrally molded into the fiberglass pit wall, and inner and outer sleeve seals. Inner sleeve seal shall have a test port to provide testing capability of institutional space. Sleeve seals shall be Buna-N.
4. Cover: Cast-aluminum ring and hinged door, 30-pound, lay flat, one-hand lift weight, 90 degree minimum door opening, water resistant, removable.
5. Provide deep-dish hand hole in cover to permit opening by gloved hand.
6. Cover assembly to be tested at 1,000 psi over 200-square-inch footprint with a maximum acceptable full-load deflection of 0.100-inch, and cover deflection rebound data shall be given at a maximum of 0.010-inch after test load has been applied and released. Covers must be free of visual shrink porosity cavity areas, weldments, fillers, and paint. A previous independent certified testing laboratory report for the cover assembly shall accompany the

Submittal data for the service pit. Weight-bearing flange surfaces of both the pit and cover shall be machined flat to a total indicator reading of +0.010-inch for flatness to assure uniform weight distribution.

7. Entire cover assembly and pit as installed shall be capable of accommodating wheel loads of any aircraft in commercial service.

8. The words "FUEL LOW POINT DRAIN" or "FUEL HIGH POINT VENT," as applicable, shall be in raised letters in the cover door.

9. A stainless steel tag with "Fuel Low Point Drain" or "Fuel High Point Vent," as applicable, shall be permanently affixed to the riser.

2.9 VAULT ACCESS COVERS.

A. General Requirements: One-piece molded fiberglass frame complete with aluminum lid(s) and step down platform.

B. Performance: Designed to permit access to fuel system concrete vault and pipe risers.

C. Construction:

1. Cover assemblies shall be manufacturer standard dimensions of approximate size indicated on structural plans.

2. Frame shall be one-piece molded fiberglass, with built-in concrete anchors. Provide removable step-down platform. Modify platform as required for vent and drain penetrations.

3. Cover: Cast-aluminum hinged door assembly, 30-pound, one-hand lift weight, 90 degree door opening, water-resistant design. Cover shall be torsional-spring or gas shock assisted opening.

4. Provide deep-dish hand hole in cover to permit opening by gloved hand.

5. Cover assembly to be tested at 1,000 psi over 200-square-inch footprint with a maximum acceptable full-load deflection of 0.100-inch, and cover deflection rebound data shall be given at a maximum of 0.010-inch after a 740-psi test load has been applied and released. Covers must be free of visual shrink porosity cavity areas, weldments, fillers, and paint. A previous independent certified testing laboratory report for the cover assembly shall accompany the Submittal data for the service pit. Weight-bearing flange surfaces of both the pit and cover shall be machined flat to a total indicator reading of ±0.010-inch for flatness to assure uniform weight distribution.

6. Entire cover assembly and pit as installed shall be capable of accommodating wheel loads of any aircraft in commercial service.

7. Pit manufacturer shall provide removable ladders for attachment to access cover assemblies where ladders are indicated on plans. Manufacturer provided ladders shall extend from at or above grade to vault floor and be equipped with handrails extending above grade when cover is opened.

8. Identification shall be provided in raised letters on access covers. Identification shall be "Fuel System Vault Access."

2.10 QUICK DISCONNECT ADAPTER.

A. Shall be a male cam-and-groove by FPT adapter, with dust cap, size as indicated.

B. Construction of adaptor and cap shall be aluminum.

2.11 PRESSURE GAUGES.

A. Per ASME B40.1.

B. All pressure gauges shall be silicon-filled type and shall have all internal parts immersed.

C. Gauges shall have 4-1/2-inch dials, 1/2-inch NPT lower stem, 316SS tube/socket and stainless steel case, and shall be mounted to the pipe by means of the instrument valves specified.

D. Gauge range shall be as indicated on the drawings.

2.12 FUELING PUMPS AND MOTORS

A. New fueling pumps and motors to be supplied and installed under this contract are to match the existing pumps and motors at the Orlando Fuel Farm as described on the drawings.

B. See Exhibit 1 for existing pump and motor information.

2.13 FILTER-SEPARATORS

A. New filter/separators to be supplied and installed under this contract are to match the existing filter/separators to at the Orlando Fuel Farm as described on the drawings.

B. Filter/separators to include appurtenances and elements as shown in the drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspect valve for cleanliness, corrosion, and operability. Remove special packing materials, such as blocks used to prevent disc movement during shipping and handling.

B. Actuate valve through an open-close and close-open cycle. Examine functionally significant features, such as guides and seats made accessible by such actuation. Following examination, return the valve's closure member to the shipping position.

C. Examine threads or flanges on both the valve and the mating pipe for form (i.e., out-of-round or indentation) and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, defects, and damage.

E. Prior to valve installation, examine the pipe for cleanliness and proper alignment.

F. Replace defective valves with new valves.

3.2 VALVE AND EQUIPMENT INSTALLATION

A. Install where indicated on the Drawings and in accordance with manufacturer's recommendations.

B. Replace any and all valves and equipment that prove defective during testing. Arrange all valves during installation such that operating handles and controls are accessible, have sufficient clearance, and in the correct orientation for Owner's operation.

C. Provide spool pieces or spacers in the piping as necessary to ensure valve parts and operators have sufficient operating clearances.

3.3 CLEANING AND PROTECTION

A. Clean all fabricated assemblies and all equipment items thoroughly before operating or testing.

B. Protect equipment from damage, deterioration, paint or coating spills or spots, corrosion, or harm from any source.

3.4 SETTING AND ALIGNING EQUIPMENT.

A. Set and align all Equipment supplied under this section in accordance with manufacturer's recommendations.

B. Set true and level all Equipment at the locations shown. Demonstrate adequate leveling of installed Equipment.

C. Retighten all bolted and threaded connections after installation.

3.5 PIT ASSEMBLIES.

A. Although the pit assemblies have been specified as assemblies, certain components may be shipped loose. Contractor shall account for all loose components and assemble.

B. Contractor shall establish and coordinate with all parties the dimension required between the top connection point of the hydrant pit valve and the hydrant pit lid/cover.

3.6 TESTING, STARTUP, AND COMMISSIONING

A. Before equipment installations will be accepted, the equipment shall be tested and demonstrated to be correctly connected and installed.

B. Adjustments and Calibration shall be performed on all equipment specified herein:

1. Contractor shall adjust all valves for the flows, level settings, and pressure settings indicated and specified.

2. Set rate of closure of valves to eliminate surges and shocks in the systems as installed.
3. Final adjustments shall be made during system operation prior to final start-up.
4. Adjust all items at start-up, including flow rates, pressure settings, meter settings, and other variables as required by Owner's Authorized Representative on the job.

C. All testing and checkout procedures of the manufacturer shall be carried out completely.

D. All tested equipment found to be defective or inoperable to any extent is to be reported to Owner immediately.

E. Any operating difficulty or defective item as a result of Contractor's work shall be repaired or replaced and put into proper operation by Contractor immediately.

F. Protect all equipment and surrounding areas from damage resulting from testing operations. Clean up any spills or leakage from testing.

G. Commissioning activities will include, but are not limited to, the following:
1. Emergency Fuel Shutoff (EFSO) System Testing
a. Prior to initial fuel receipt, verify that each EFSO pushbutton will trigger local and remote alarms and close the control valves as intended.
b. Verify that resetting each EFSO and clearing the alarm will return the valves to normal operation.
2. Piping System
a. Ensure that all piping weld integrity and coating inspections have been performed per the applicable specifications.
b. Evacuate all accumulated water from piping low point drains, valve cavities, and equipment drains.
c. Verify all bolted connections are tightness tested to required torque using a calibrated torque wrench.
d. Verify that all pressure gauges are properly located and installed.
e. Ensure that piping's cathodic protection system is tested and operational.

f. Ensure that pipe marking and identification is provided as specified.

g. Verify the correct installation of pipe supports.

h. Verify the Leak Detection system is operational and functioning as designed.

3. Control Valve Adjustments

a. All control valve settings shall be checked and field adjusted from the factory settings at start-up as necessary to provide a smooth operation.

b. Adjustments to valves shall be made only by the Valve Manufacturer's authorized Field Test Engineer.

c. Control valve field adjustments shall be made to all new control valves including hydrant pit valves, refurbished control valves at the Fuel Farm, existing backpressure and rate-of-flow control valves at the Fuel Farm, and all existing Hydrant Valves at the North Terminal.

4. Fuel Farm Control System Testing

a. The Fuel Farm Control System shall be modified as necessary to incorporate the two new pumps and filter/separator trains into the control system and human-machine interface (HMI).

b. Contractor is to engage the services of the control system manufacturer and programmer to perform modifications to the Fuel Farm Control System.

c. Final field testing shall include an on-site representative of the control system manufacturer to perform any final field adjustments necessary to the control system including but not limited to adjustment of setpoints, time delays, flow rates, pressures, and data recording.

5. Hydrant System Performance Testing

a. Prior to acceptance, the Contractor must demonstrate the following:

b. Operation of all pressure and flow devices to automatically start and stop the fueling pumps at the indicated pressures and flow rates. The

operating sequence shall be repeated with each of the pumps being selected as lead pump.

c. System's ability to deliver fuel to multiple fueling points at specified flow rates.

d. Control valve surge shutdown and pressure control features.

6. Upon completion of commissioning activities, all performance testing will be summarized in a Commissioning Report for submittal to the Owner's Authorized Representative.

H. Upon completion of work, the Contractor shall provide the services, for a period of not less than two - eight hour working days, of qualified technicians, certified by the manufacturer(s) as being experienced in the various aspects of the installations, to instruct representatives of the Owner and the Airlines in the operation and maintenance of the system.

END OF SECTION 33 5247

EXHIBIT 1

EXISTING PUMP AND MOTOR DATA

SOURCE: ORLANDO BULK FUEL FACILITY & HYDRANT SYSTEM, OPERATIONS & MAINTENANCE MANUAL ISSUED JULY 16, 2016

SECTION 33 52 53 - INSPECTION, TESTING, AND FLUSHING

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 includes the inspection, pigging, testing, and flushing of all piping and equipment performance. Also included is soak testing.

B. Provide for the "Gas Free" conditions required by SECTION 33 52 45, as applicable to the Work of this Section.

1.3 REFERENCES

A. Airlines for America:

1. ATA Spec 103-2017 - Standards for Jet Fuel Quality Control at Airports.

B. American Society for Testing and Materials (ASTM):

1. D1655 - Specification for Aviation Turbine Fuels.
2. D2276 - Test Methods for Particulate Contaminants in Aviation Turbine Fuels.
3. D4176 - Standard Test Method for Free Water and Particulate Contamination in Distillate Fuels.

C. American Society of Mechanical Engineers (ASME):

1. B31.3 - Process Piping.

D. Joint Inspection Group

2. JIG Bulletin No. 35 Soak Testing.

E. National Fire Protection Association (NFPA):

1. 407 - Standard for Aircraft Servicing.

1.4 SUBMITTALS

A. Submit detailed procedures for testing methods for approval before proceeding with pipe fabrication. This includes all weld inspection, pressure testing, and flushing.

B. Submit examination personnel qualifications before proceeding with any testing method.

C. Submit completed examination procedures with actual testing data (readings) and signatures of examination personnel.

1.5 QUALITY ASSURANCE

A. All tests and examinations shall be performed in accordance with ASME B31.3.

PART 2 - PRODUCTS – Not Applicable.

PART 3 - EXECUTION

3.1 GENERAL

A. Compressors used for air testing shall have sufficient capacity to bring the system under test up to the test pressure in a maximum of 20 minutes.

B. Owner will furnish all fuel for testing and flushing except as otherwise specified.

C. Contractor shall furnish and operate all equipment required, including holiday detectors, tankers, fuel transport trucks, gauges, instruments, hoses, connections, temporary pumps, temporary filter separators, and other items specified or required.

D. Procedures:

1. Perform holiday testing of coating systems on all piping including joints.
2. Pneumatically test fuel (carrier and containment) piping.
3. Pig the lines to remove debris.
4. Hydrostatically test fuel (carrier) piping.
5. Flush fuel (carrier) piping.
6. Soak Test the piping.
7. Electrically test all insulating flanges and joints.
8. Water shall not be used for testing fuel piping.

E. Responsibility of Contractor:

1. Notify the proper authorities and Owner’s Authorized Representative that items are ready for inspection and testing. Twenty-four hours' notice shall be given for all inspection and tests.
2. Furnish and install all necessary equipment, materials, and personnel including pumps, compressors, gauges, and valves. Valves shall be approved by Owner’s Authorized Representative and shall be suitable to hold test pressure for the specified time without leakage.
3. Conduct the tests of all systems in a safe manner and correct all deficiencies.
4. Apply the specified test pressures by means of a pump or compressor connected to the piping of highest elevation, and plug tightly afterwards.
5. Be fully responsible for operating trucks and equipment throughout the testing and flushing operations.

6. Obtain and pay for all necessary approvals, acceptances, and permits.
7. Contractor shall make provisions to conduct all tests during inclement weather, if necessary.

F. Contractor shall be responsible for preventing and controlling spills resulting from its Work. Contractor shall become familiar with the facility's most current Spill Prevention, Control and Countermeasure (SPCC) and Spill Prevention Response (SPR) Plan.

3.2 FUEL HANDLING

A. Contractor shall not waste, spill, or contaminate the fuel used or encountered during testing, filling the system, decommissioning of exist fuel lines, drain-downs, and other Work requiring fuel to be removed from the fueling system. The cost of all fuel spilled, wasted, or contaminated as a result of Contractor's operations will be the responsibility of the Contractor.

B. All fuel required for flushing, testing, etc. will be supplied by the Owner. Fuel shall remain the property of the Owner upon completion of flushing, testing, etc. after the fuel quality has been tested and found acceptable. See below criteria for acceptable fuel quality ("Acceptance Criteria"). Contractor shall transport acceptable fuel to a location designated by the Owner's Authorized Representative.

However, fuel that is unacceptable (does not meet the below "Acceptance Criteria") shall be removed from the Site and disposed of at Contractor's expense along with reimbursing the Owner for the cost of the fuel.

C. After testing, approval, and inventorying the fuel removed from the system by Contractor as required to complete Work, Contractor shall transport the fuel removed from the fuel system and fuel system piping to a location designated by the Owner's Authorized Representative.

D. Acceptance Criteria: Refer to ATA 103, latest edition.

E. Contractor shall use certified clean, detergent free (steam cleaned) temporary tanks, tanker trucks, etc. for storing and transporting fuel removed from the system. Interior coatings of temporary tanks, tanker trucks, etc. used shall be compatible with Jet A/A-1.

3.3 PIGGING

A. Contractor is responsible for providing all temporary equipment including pig launchers, pig receivers, cleaning pigs, pipe spools, and other appurtenances and equipment as necessary to accomplish the pigging of all new piping installed under this project.

B. Contractor is responsible to remove the temporary equipment and re-install valves and fittings which may have been removed to enable pigging operations.

C. Pigging of new piping installed under this project shall be performed prior to tie-ins to the existing fuel piping.

D. Each section of pipe shall be pigged use a bare swab foam pig to remove debris

and water in the pipe.

E. Pigs shall be replaced when excessive dirt and debris rip and tear the pig's surface.

F. Pigging shall be accomplished using dry compressed air to propel pigs through the pipe.

G. Pigging shall continue until the pipe is free of debris.

3.4 FUEL PIPING PNEUMATIC PRESSURE TEST

A. A pneumatic test shall be applied in accordance with ASME B31.3, latest edition, to the entire length of buried fuel pipe installed under this Contract.

B. All pneumatic testing shall be done using dry compressed air at -20^{O}F dew point.

C. Install temporary closures or other fittings, including Victaulic coupling caps, blind flanges, and similar items, as necessary for the integrity of the piping system to be tested. Permanent valves and adapters shall be in place for testing.

D. Backfill between joints before application of test pressure.

E. The pressure shall be gradually increased until a gauge pressure which is one-half the test pressure, 13 psig, is attained, at which time a preliminary check shall be made, including examination of exposed joints in accordance with ASME B31.3. Thereafter, the pressure shall be gradually increased in steps until the test pressure of 25 psig is reached, holding the pressure at each step long enough to equalize piping strains.

F. Maintain 25 psig pressure for at least 2 hours.

G. Soap exposed joints and carefully inspect to detect leaks.

H. Pressure and temperature reading shall be taken as follows:

1. Temperatures shall be representative of actual conditions.

2. Readings shall not be taken during times of rapid atmospheric changes.

3. There shall be no indication of reduction in test pressure after corrections for temperature and pressure have been made according to the relationship $T_1 P_2 = T_2 P_1$, where T and P are absolute temperatures and pressures and subscripts refer to initial and final readings.

I. Repair defective joints and repeat tests until approved.

3.5 CONTAINMENT PIPING PNEUMATIC PRESSURE TEST

A. A pneumatic test shall be applied in accordance with ASME B31.3 to the entire length of buried containment pipe installed under this Contract.

B. All pneumatic testing shall be done using dry compressed air at -20ºF dew point.

C. Install temporary closures or other fittings, including Victaulic coupling caps, blind flanges, and similar items, as necessary for the integrity of the piping system to be tested. Permanent valves and adapters shall be in place for testing.

D. Backfill between joints before application of test pressure.

E. The pressure shall be gradually increased in steps until the test pressure of 50 psig is reached, holding the pressure at each step long enough to equalize piping strains, at which time a check shall be made, including examination of exposed joints in accordance with ASME B31.3.

F. Maintain 50 psig pressure for at least 2 hours.

G. Soap exposed joints and carefully inspect to detect leaks.

H. Pressure and temperature reading shall be taken as follows:

1. Temperatures shall be representative of actual conditions.

2. Readings shall not be taken during times of rapid atmospheric changes.

3. There shall be no indication of reduction in test pressure after corrections for temperature and pressure have been made according to the relationship T1 P2 = T2 P1, where T and P are absolute temperatures and pressures and subscripts refer to initial and final readings.

I. Repair defective joints and repeat tests until approved.

3.6 FUEL PIPING HYDROSTATIC PRESSURE TEST

A. Apply a liquid pressure test with jet fuel to the entire system following the pneumatic pressure test.

B. The pressure shall be gradually increased until a gauge pressure which is one-half the test pressure is attained, at which time a preliminary check shall be made, including examination of exposed joints in accordance with ASME B31.3. Thereafter, the pressure shall be gradually increased in steps until the test pressure of 275 psig is reached, holding the pressure at each step long enough to equalize piping strains.

C. The test pressure of 275 psig shall be maintained for at least 4 hours.

D. Decrease pressure by venting at high points and then increase again to the test pressure and hold again for a 72-hour period.

E. Repair any leaks in a manner approved by Owner's Authorized Representative.

F. Provide calibrated temperature and pressure instruments and chart recorders to provide continuous temperature and pressure readings variations during the tests. Instruments shall be calibrated for temperature and pressure immediately prior to each test. Recorder charts shall be submitted to Owner's Authorized Representative for review prior to final acceptance of the piping.

G. Permanent valves and adapters which are rated for the test pressure shall be in place for the liquid pressure test. Equipment which is not rated by the manufacturer for the test pressure shall be removed prior to testing. Install temporary connections as necessary.

H. For additions or connections to other modifications, where isolation for the liquid pressure test is not feasible, radiographing of the welds and careful observation of the system piping put under operating pressure with fuel before joints are covered

will satisfy the requirement for this testing. This includes points of system interconnection and blanked off tank connections and other miscellaneous piping modifications.

3.7 TESTING PLAN

A. Contractor shall prepare and submit a testing plan that identifies sequence, schedule, and extent of piping undergoing NDE, pneumatic, and hydrostatic testing, inspection, and examination for each phase of work.

B. NDE and hydrostatic testing new piping shall be complete prior to installation of tie-in segments to connect new piping to existing piping.

C. Tie-in segments shall be hydrostatically prior to installation to connect new piping to existing piping.

D. Testing, inspection, and examination of tie-in welds shall be as specified.

3.8 NITROGEN CHARGING OF FUEL AND CONTAINMENT PIPING

A. Fuel piping to be drained and remain out of service and all containment piping shall be charged with 15 psig of nitrogen.

B. Fuel piping to be drained and charged with nitrogen includes the 14-inch/18 inch pipe from BV-5 to the end of the pipe loop on the South, the pipe from BV-7 to the end cap on the South, and from BV-6 to the end cap on the North.

~~A.~~C. Following approved pneumatic test and hydrostatic pressure test, fuel piping to remain out of service and all containment piping shall be charged with 15 psig of nitrogen.

3.9 INSPECTION OF COATINGS

A. Contractor shall make a detailed inspection with a holiday tester of all pipe coating and joint coating preceding the lowering of the pipe.

B. Holiday-tester voltage shall not be higher than the manufacturer's recommended voltage for the coating tested. Testing shall be for holidays only and not to test the dielectric strength of the coating materials.

C. All holidays and damaged or broken places in the coating shall be repaired in a workmanlike manner at Contractor's expense.

D. All holidays shall be patched using the methods specified for field-applied external protective pipe coating and procedure in SECTION 33 52 46.

3.10 FLUSHING

A. Before new, modified, or repaired fuel piping, or portion thereof, is placed into service, all piping affected by change shall be flushed to ensure system cleanliness before the new, modified, or repaired fuel piping may be use to refuel aircraft.

B. All flushing procedures, fuel sampling, and testing shall be in accordance with ATA 103, latest revision.

C. The installing Contractor shall be responsible for all flushing requirements. The

Contractor shall prepare and submit for review a detailed flushing plan describing all the piping and equipment planned to be used for the flushing operation. The submittal shall include temporary pumps, piping, valves hoses, temporary tanks ultrasonic meter and all related appurtenances. Submit calibration certs for all gauges and meters. Prepare hydraulic calculation for flushing circuit to verify flow rate needed to attain the flushing velocity. Flushing plan to be prepared by an engineer experienced in preparing flushing plans. Provide for secondary containment for tanks, pumps and piping and for Emergency Fuel Shut Off during flushing operation. Plan is to be submitted 8 weeks prior to flushing to allow time to obtain approval from airline and fuel system operator before flushing begins.

D. A reasonable amount of fuel required for flushing and testing will be supplied by Owner. Owner will arrange for making the fuel available to Contractor. Contractor to transport flushing fuel to site and fill piping and temporary tanks. Contractor shall provide temporary hose rated for 350 psig and conforming to EI 1529 and piping as required to obtain fuel from Owner.

E. Product used for flushing shall meet ASTM D1655, latest revision, specifications for kerosene Jet A/A-1 type aviation grade turbine fuels.

F. Flushing flow rate shall be a minimum of 10 feet per second. Additional temporary pumps and filters, if required to provide minimum flow velocity, shall be provided by Contractor. At a minimum, three times the line volume of the new pipe shall be flushed through the new piping.

G. Test samples shall be drawn immediately ahead of filtration on closed loop recirculation systems; immediately ahead of storage tanks in receiving manifold on recirculation systems returning flushed fuel to tankage; or immediately ahead of transport trucks on single line systems.

H. No flushing will be allowed through hydrant pit valves or control valves.

I. Temporary piping connections to form a closed loop piping system shall be installed and the system flushed by means of recirculation. All temporary cross connections or special fabrication of adapters required shall be provided by Contractor. Refer to Drawings for proposed flushing configuration.

J. All general service valves and adapters shall be in place throughout the flushing procedure along with temporary valves and connection to expedite flushing procedures.

K. Contractor shall provide all filtration media required for return of fuel to the airport fuel storage facility or other location designated by the Owner following the system flush. This includes intermediate filtration media changeouts if excessive media loading or disablement occurs during return of flushed fuel to the fuel storage facility. Contractor shall again provide new filtration media if replacement is determined necessary by the Owner’s Authorized Representative due to filter element loading from the return of flushed fuel. Contractor shall reimburse the Owner for fuel facility operator labor costs incurred during these filter media changeouts.

L. For flushing into Tank Trucks or Temporary Tanks, Contractor shall supply any

temporary manifolds plus sufficient number of single compartment tank trucks or industry standard temporary tanks and hoses to allow the desired flow rates to be achieved in a safe manner. Hoses and couplings shall be aircraft type with a minimum 350 pound rating and shall be hydrostatically tested.

M. Procedure:

Caution: All electrical and motorized equipment in area should be shut down in case of a mishap or fuel spill. For safety, all persons not involved in the flushing operation shall be kept a minimum of 100 feet away from tank trucks and temporary tanks used in the flushing operation.

a. Tank truck internal valves should be safety wired in an open position.

b. Dry break couplers shall be provided at the end of all truck and temporary tank feeder hoses.

c. All quick-release type couplings shall be safety wired when coupled to the bottom load receptacle and hydrant adapter.

d. Hoses shall be secured in a manner to prevent whipping during flush.

e. Bond trucks and temporary tanks to system piping.

f. Start product flow slowly before reaching flushing velocity to check for leaks and system tightness.

g. Fire extinguishers shall be in place in case of emergency.

h. Each tank shall have DOT tape on all sides, markings on all sides identifying the type of fuel in the tank, and a cargo tank test certification.

i. Location of test personnel:

(1) One person per each tank truck and temporary tank to monitor fuel level in tanks.

(2) One person at hose inlet connection to control flow of fuel into truck or tank.

(3) One person at main pump control station to shut down pumps in emergency.

(4) One person at nearest terminal EFSO or ESD station to shut down pumps in emergency.

(5) One person operating fire extinguisher(s).

(6) One person removed from manual tasks in command of flushing operation.

N. Flushing shall be accomplished by flushing fuel from the temporary tank, through the pumping/filter system, around the closed loop piping system, to the temporary tank. Hydrant lateral flushing shall be through lateral into truck.

O. Contractor shall provide aboveground "test tee" for membrane test to be performed during and for acceptance flushing. Visual, membrane and water testing shall be

performed continuously during the flushing operation to document the trend to the acceptance specification.

P. After main pipeline is clean, each hydrant lateral shall be flushed clean into a transport truck.

Q. The Contractor shall provide the required fuel quality tests from a certified laboratory provided by the Contractor.

R. Acceptance Specifications:

1. Visual - All fuel samples shall be clear and bright. Other visual clues must be observed and acted upon accordingly, i.e.; feel, color, odor, and similar characteristics. This test shall be performed in accordance with ASTM D4176.

2. Perform a membrane test per ASTM D2276. A minimum of 1 gallon of jet fuel shall be used for this test. Visually assess the membrane and compare it with a color rating booklet. The color shall be a maximum of A3, B3 or G3 rated wet with a particulate assessment not exceeding the B scale. Flushing shall continue and the membrane tests repeated until two consecutive tests are obtained which meets these requirements.

3. Fuel shall be tested in the field for free water per ASTM D-3240 using testing equipment as manufactured by Gammon Technical Products, specifically the "Aqua-Glo Water Detector".

4. Fuel shall be tested in the field for its ability to shed water by performing the water separation test (MICROSEP) per ASTM D-3948.

Note: If color rating exceeds the above limits or is in dispute, a matched weight gravimetric rating not to exceed 0.5 mg/gal shall govern.

5. Free Water - 30 ppm maximum.

6. Water Separation (Microsep) Rating - 85 minimum.

S. Final Acceptance:

1. It shall be the responsibility of the airline fuel quality assurance representative, or his designee, to have final decision on system cleanliness and acceptance before aircraft fuel servicing is permitted.

2. The Contractor shall prepare and submit a final flushing results report. The report shall include the the detailed flushing plan, the visual test, the membrane test, free water test, Microsep test, a narrative describing flushing process, photos of the test set up and a statement that the the fuel system was flushed according to ATA 103 and the contract documents.

T. After all flushing and control valve adjustments has been completed and approved, Contractor shall remove all temporary cross connections and related items, install and restore other system components.

3.11 CONTROL VALVE ADJUSTMENTS AND PERFORMANCE TESTING

A. Contractor shall subject the entire fueling system to such operating tests as required by Owner's Authorized Representative, to demonstrate satisfactory functioning and operating efficiency.

B. After pipe flushing is complete, the control valves shall be installed and the flushing circuit modified to allow the adjustment of the control valves by a manufacturer's representative. The temporary tanks at the terminus of the hydrant lines shall be left in place to receive fuel supplied by the fuel system pumps during adjustment. The control valve parameters shall be adjusted by the manufacturer's representative. The Contractor to empty temporary tanks as required to perform testing. Provide for two 10 hours nighttime work periods for control valve adjusting and testing.

C. All instruments required to conduct the tests shall be furnished by Contractor.

D. All tests may be witnessed by the Owner's Authorized Representative.

E. Submit typed samples of test reports to Owner's Authorized Representative for approval.

F. Submit completed test reports.

3.12 FUEL SYSTEM SOAK TESTING

A. The Contractor shall perform a soak test as described in JIG Bulletin No. 35 to determine potential contaminates from internal lining solvents, greases, weld flux, or other debris have dissipated into the Jet A. The Contractor shall obtain a copy of JIG Bulletin No. 35 and comply with all provisions and requirements for soak testing pipework and hydrant systems.

B. The new fuel system, as shown, shall be left to soak for a period of seven (7) days. The soak test shall be perform after all valves and equipment have been installed and operated.

C. As indicated in JIG Bulletin No. 35, the Contractor shall take a retention sample of the fuel prior to filling the fuel system pipes. At the end of the pipes soaking period, the Contractor shall take fuel samples at various locations of the fuel system, and shall submit the retention sample and the post-soak samples to a certified laboratory for quality analysis.

D. If the test results of the post-soak samples do not comply with the ASTM D1655 specifications for Jet A fuel, the Contractor, at its own expense, shall remove the fuel from the entire fuel system, dispose of the fuel, refill the system with ASTM D1655 specification grade Jet A fuel, and the soak test repeated until a satisfactory soak test is obtained.

E. The Contractor shall submit a detailed soak test procedure to the airline fuel quality assurance representative and fuel facility operator for approval.

F. The Contractor and the testing lab shall prepare and submit a final report detailing the locations of the soak testing and presenting the soak test results.

END OF SECTION 33 52 53

SECTION 34 70 00 – FDOT STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, DATED 2017

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, 2017 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, 2017 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

SECTION 34 71 13.16 - VEHICLE CRASH BARRIERS

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 all sustainability requirements), apply to this Section.

B. FDOT standard concrete traffic barriers.

1.2 SUMMARY

A. Included in this section

1. Pre-wired drop arm vehicle barrier, including all selected attachments and accessory equipment. Complete with all pumps, valves, cylinders and electrical devices to move barrier arm and limit its travel in both directions.

B. Related work specified elsewhere

1. Section 03 30 00 “Cast-In-Place Concrete”.
2. Section 26 05 12 “OUC Underground Electric”.
3. Section 32 31 19 “Fence and Gates”.

1.3 SUBMITTALS

A. Shop drawings: Submit shop drawings under the provisions of Section 01 33 23 “Shop Drawings, Product Data, and Samples”. Submit drawings showing connections to adjacent construction, range of travel, and all electrical and mechanical connections to the barrier. All underground runs of electrical lines and inductive vehicle obstruction loop locations shall be indicated on drawings. Drawings shall also show the size and location of the concrete footings.

B. Installation instructions: Submit two copies of manufacturer's installation instructions for this specific project.

C. Submit manufacturer’s completed warranty.

D. Project list: Submit list of product installations comparable to the subject job. Include date of product installation, installer, and owner's name and location of the project.

E. Test reports:

1. Submit affidavits from the manufacturer demonstrating that the barrier mechanism has been tested to 200,000 cycles without breakdown.
2. Each operator shall bear a label indicating that the operator mechanism has been tested. Operator is tested for full power and pressure of all hydraulic

components, full stress tests of all mechanical components and electrical tests of all overload devices.

1.4 QUALITY ASSURANCE

A. Manufacturer: A company specializing in the manufacture of Anti-Ram barriers of the type specified, with a minimum of five years' experience manufacturing operators of this type and design.

B. Installer: Must have a minimum of three years' experience installing similar equipment, provide proof of attending a Manufacturer Technical Training within the previous three years, or obtain other significant manufacturer endorsement of technical aptitude, if required, during the submittal process.

1.5 CODES AND REGULATORY REQUIREMENTS

A. Electrical Panels shall be built and labeled to UL508A standards. Complete all electrical work according to local codes and National Electrical Code. All fieldwork shall be performed in a neat and professional manner, completed to journeyman standards.

B. Vehicular barriers should never be used by pedestrians. A separate pedestrian entrance must always be provided when foot traffic is present.

C. Florida Department of Transportation Guidelines.

1.6 PRODUCT DELIVERY AND STORAGE

A. Store products upright in the original shipping containers, covered, ventilated and protected from all weather conditions.

1.7 WARRANTY

A. Provide a warranty against all defects in materials or workmanship for five years or 500,000 gate cycles (whichever occurs first) after the date of installation. Defective materials shall be replaced at manufacturer's discretion with new or reconditioned materials furnished by the manufacturer, at no cost to the owner. Freight, labor and other incidental costs are not covered under the factory warranty, but may be covered by a separate service agreement between installing company and the owner.

PART 2 - PRODUCTS

2.1 VEHICLE BARRIERS

A. Active Anti-Ram Crash Barrier M50 with Smart Touch Controller, or other comparable barrier, as approved by the architect or specifier. Substitute barriers that are approved will be published in an addendum, not less than ten days prior to bid opening.

Requests for substitution will include the amount of savings to be passed on to the owner.

2.2 OPERATION

A. Operation shall be by means of dual acting hydraulic cylinder acting directly on the drop arm to move the arm through 90°. The arm travel time varies depending upon version ordered, see schedule below. Operation to the fully open and fully closed position shall be continuously monitored by an absolute position sensing device that accurately reads the position of the cylinder and arm. The system shall function normally without need for springs or weights to counterbalance the arm. Gears, sprockets, belts or pulleys shall not be incorporated in the operator. Arresting of vehicles shall be accomplished by polymeric straps suspended in the arm. All models include a variable speed motor drive and two brake valves to gradually stop and hold the arm without applying a shock load to the arm or barrier assembly. Barrier shall hydraulically lock in the closed position.

B. The vehicle barrier shall be certified by a third party licensed engineer to be capable of withstanding a direct impact from a vehicle to the M50 level specified in ASTM F2656 for 12 ft (3,657 mm) and 24 ft (7,315 mm) lengths. The vehicle barrier shall have successfully passed testing at an accredited test facility to ASTM F2656 as validation of the engineering certification.

C. Safety Features shall include as a minimum:

1. Lower barrier arm at a height of 18” (457 mm) from grade to prevent smaller vehicles from penetrating under the main barrier arm.
2. The barrier arm shall contain LED warning lights to enhance night visibility.
3. The barrier shall include a red – amber stoplight to display status to vehicles.
4. A photoelectric eye capable of detecting a person or vehicle in the path of the barrier to prevent closure of the barrier arm when an obstruction is present. This feature shall not be active during Emergency Fast Close.
5. Shield to prevent entrapment of bystanders between arm and catch post.

D. Schedule of length and speed capacities:

1. 12-14 ft (3,657-4,267 mm) clear opening: Travel time not to exceed six seconds from fully closed to fully open position. Maximum clear opening shall be 14 ft (4,267 mm).
2. 16-18 ft (4,867-5,486 mm) clear opening: Travel time not to exceed seven seconds from fully closed to fully open position. Maximum clear opening shall be 18 ft (5,486 mm).
3. M50 20-24 ft (6,096-7,315 mm) clear opening: Travel time not to exceed eight seconds from fully closed to fully open position. Maximum clear opening shall be 24 ft (7,315 mm).
4. All units shall contain, as standard equipment, a provision for Emergency Fast Close operation that shall move the barrier from fully open to the fully closed position in 1.5 seconds less than the normal travel time to open.

E. Minimum standard mechanical components:

1. Chassis: shall be 3/8” (9 mm) steel plate, welded, and edges ground smooth.
2. Cover: shall be 14 gauge (2 mm) galvanized sheet steel, with a security lock to limit access.
3. Main shaft: shall be 3" (76 mm) diameter, high strength steel alloy.
4. Heavy duty sealed 1-15/16" (49 mm) bearings, with cast iron pillow blocks.
5. Resilient physical stop limiting open and close travel and to cushion stop at each end of travel.
6. Hydraulic hose: Shall be 3/8" (9 mm) wire braid reinforced, rated to 3,050 psi (21.0 MPa).
7. Hydraulic valves: Shall be individually replaceable cartridge type, in an integrated hydraulic manifold.
8. Hydraulic fluid: High performance type with a viscosity index greater than 375 and temperature range -40° F to 167° F (-40° C to 75° C). (optional biodegradable fluid requires a heater at temperatures below -10° F (-24° C))
9. A zero to 2,000 psi (13.7 MPa) pressure gauge, mounted on the manifold for diagnostics, shall be a standard component.
10. The hydraulic fluid reservoir shall be formed from a single piece of metal, non-welded, and shall be powder painted on the inside and the outside, to prevent fluid contamination.
11. Manual operation: in the event of a power outage the use of a “pull to release” bypass valve shall unlock the operator and allow the arm to be operated by a hand pump.
12. Arm: Aluminum oval shape for optimal strength, wind resistance and corrosion protection
13. Arm striping: shall be highly reflective alternating red and white vertical stripes, 16” (406 mm) intervals measured horizontally per MUTCD standards.
14. Finish: hot dipped galvanize coating per ASTM A123 G85.
15. Red LED lights shall be integrated into the barrier arm.

F. Minimum standard electrical components:

1. Pump motor: 2 hp, 3450 RPM, 56C, TEFC, three phase. (Note, the VFD converts single phase input power to drive a three phase motor)
2. All components shall have overload protection.
3. Variable frequency drive to enable variable displacement pump operation.
4. Controls:
    a. built in warning buzzer for Emergency Fast Close and in the event of Alerts, Faults, or Errors;
    b. built in timer to close;
    c. 32 character OLED display for reporting of functions and codes;
    d. multiple programmable output relay options;
    e. anti-tailgate mode;
    f. built-in power surge/lightning strike protection;
    g. menu configuration, event logging and system diagnostics easily accessible with a PC.

h. RS-232 port for connection to laptop or other computer peripheral and RS-485 connection for network interface.
i. Dual gate communication connection for bi-parting, sally port, or sequenced gates.
j. Electromechanical and solid state relays.
k. Radio option outputs.
l. 21 inputs for site specific configurations.

5. Control circuit: 24 VDC.
6. Transformer: 75 VA, non-jumpered taps, for all common voltages.
7. Sockets for up to four plug-in vehicle detectors.
8. Open and close limits shall be via encoder, providing continuous position sensing of arm position and the stop positions shall be adjustable from the controller with an LCD display.

G. Optional control devices (choose one or more of the following): card reader, key switch, radio control, pushbuttons, free egress vehicle detectors, vehicle obstruction loop detectors, reset loop, keypads, seven day timers or various emergency vehicle open devices as dictated by local code.

H. Optional alert devices: Flashing lights or rotating beacon. Configurable audible beacon included as standard.

2.3 FACTORY TESTING

A. Fully assemble and test, at the factory, each barrier to assure smooth operation, sequencing and electrical connection integrity.

B. Inspect and test all hydraulics are leak free.

C. Maintain records of material and process traceability for all critical structural elements.

D. Check all mechanical connections for tightness and alignment. Check all welds for completeness and continuity.

E. Inspect finishes for completeness. Touch up imperfections prior to shipment.

F. Check all hydraulic hoses and electrical wires to assure that chafing cannot occur during shipping or operation.

2.4 TEMPORARY CONCRETE BARRIERS

A. Provide FDOT 415 temporary concrete barrier wall unit meeting all requirements of the most current FDOT design standards with the following options:

1. Standard design round bar connectors.
2. Steel surface anchor plates.

PART 3 - EXECUTION

3.1 SITE EXAMINATION

A. Locate concrete footings forms in accordance with approved shop drawings and in compliance with local building codes.

3.2 INSTALLATION

A. Install barrier in accordance with the safety regulations and the manufacturer's product literature and installation instructions, current at the time of installation. Coordinate locations of operators with contract drawings; other trades and shop drawings.

B. Installer shall ensure that the electrical service to the barrier is at least 20A. Electrical wiring to conform to NEC and manufacturer's installation instructions. Active Anti-Ram Crash Barrier M50 is 3000W.

3.3 BARRIER SITING AND SAFETY PRECAUTIONS:

A. Careful consideration must be given to the selection, placement, and design of a vehicle barrier installation. As is the case with any active vehicle barrier system, perimeter security device, or security gate that blocks a roadway, it is essential to ensure that approaching vehicles as well as pedestrians are fully aware of the presence of the barrier and its operation. Installer will work with End User Customer to provide proper illumination and clearly worded signage (with appropriate graphics) warning of the barrier's presence and its hazards. The manufacturer strongly recommends that an architect and/or traffic and/or safety engineer be consulted before installing any active vehicle barrier and that an installation configuration be employed that physically limits approach speeds to no more than 20 MPH. End User Customer agrees that it will be responsible for selecting the location of the barrier and the configuration of approaches and warnings. The Manufacturer will offer reasonable assistance in integrating the barrier with external and existing systems, but it does not provide traffic or safety engineering services.

3.4 FIELD QUALITY CONTROL

A. Test operator through ten full open and close cycles and adjust for operation without binding, scraping or uneven motion. Test limit switches for proper open and close limit positions.

B. All anchor bolts shall be fully tightened in the finished installation.

C. Owner, or owner's representative, shall complete "punch list" with installing contractor prior to final acceptance of the installation and submit completed warranty documentation to manufacturer.

3.5 DEMONSTRATION AND TRAINING

A. Train owner's personnel on how to safely shut off electrical power, release and manually operate the barrier. Additionally, demonstrate the general maintenance of the gate operator and accessories and provide one copy of “Programming and Operations Manual” for the owner's use. Manuals will identify parts of the equipment for future procurement.

B. Refer to Section 01 79 00 “Demonstration and Training” for additional requirements.

END OF SECTION 34 71 13.16

SECTION 34 77 13 - PASSENGER BOARDING BRIDGES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and Division 0 BIDDING AND CONTRACT REQUIREMENTS and Division 01 GENERAL REQUIREMENTS Specification Sections apply to this Section:

1.2 SUMMARY

This Section includes the following:

A. Passenger Boarding Bridges: Provide new apron drive passenger boarding bridges (PBB), complete including all structural, support, mechanical, electrical, and finish requirements to serve the aircraft mix indicated on the drawings.

B. Fixed Walkways: Provide new fixed walkways as indicated on the drawings and in these specifications. The fixed walkway shall meet all structural, dimensional, and finish requirements specified for the PBB.

1.3 INTENT

A. The intent of this specification is to describe the design requirements, quantities, performance, and maintenance properties of the passenger boarding bridges required at Orlando International Airport (MCO). Operator training, maintenance training, installation requirements, and acceptance conditions are also requirements of this Specification.

B. Safety to passengers, other personnel, aircraft, and equipment is of prime importance. Nothing in these specifications shall relieve the Contractor of the responsibility for providing a safe product.

1.4 APPLICABLE STANDARDS:

A. The design, fabrication, and construction, including all manufactured components, fittings, and hardware, shall be in U.S. standard units (metric or SI units shall be presented in parentheses following the U.S. standard units), and shall conform to the current issue at the time this project is advertised, of one or more of the following codes and standards as applicable and as referenced herein:

1. City of Orlando and Greater Orlando Aviation Design Standards
2. Society of Automotive Engineers (SAE)
3. American Society for Testing and Materials (ASTM)
4. American Welding Society (AWS)

5. American Iron and Steel Institute (AISI)
6. American Society of Mechanical Engineers (ASME)
7. American National Standards Institute (ANSI)
8. National Electric Code (NEC)
9. National Electrical Manufacturers Association (NEMA)
10. National Fire Protection Association (NFPA)
11. Florida Building Code (FBC)
12. American Institute of Steel Construction (AISC)
13. Occupational Safety and Health Administration (OSHA)
14. Underwriters Laboratory (UL)
15. Americans with Disabilities Act (ADA)
16. Florida Accessibility Code for Building Construction (FACBC)
17. Society for Protective Coatings (SSPC)

1.5 SUBMITTALS

A. Shop Drawings Product Data and Samples: Submit complete and detailed shop drawings for review in accordance with the requirements of Division 01. No fabrication and/or assembly of any of the passenger boarding bridge components shall begin until the shop drawings for such components have been reviewed and approved by the Owner's Authorized Representative (OAR). Additional shop drawings shall be submitted as necessary to fully describe the PBBs to be delivered and ensure proper interface with the external environment. All drawings, sketches, details, and material shall be submitted in the English language and in Inch-Pound units, including dimensions, volumes, weights, and forces. Shop drawings shall include but not be limited to the following:

1. An index prepared in chronological order listing all drawings, sketches, details, and material submitted.
2. Product Data: Manufacturer's technical product data, including specifications. Include data substantiating that materials comply with requirements.
3. Interior Finishes:

    a. Interior finish schedule including interior wall and ceiling finishes.
    b. Transition details.
    c. Wall finish attachment methods.
    d. Light fixture details, ceiling materials, layout, and maintained illumination calculations at floor using the actual interior finishes
    e. Joint details.
    f. PBB section dimensions and general arrangement drawings.
    g. Tunnel floor finish.
    h. Cab floor finish.

i. Flooring edging details, including lines of demarcation to/from hard surfaced floor at wall areas, and treatment at doors and thresholds.
j. Floor Covering (by Owner).
k. Insulation.
l. Handrail details.
m. Duct system for PBB air conditioning unit.

4. Exterior Configuration:

a. General PBB and Fixed Walkway layout.
b. Exterior elevations.
c. Graphics/signage details.
d. Paint finishes.
e. Flashing (building to PBB & Fixed Walkway sections)
f. Ramp service stairway.
g. Baggage chute.
h. Service/maintenance ladder, cage and cab roof handrails.
i. Hurricane tie down details and locations.
j. PBB wall penetration and exterior duct.

5. Cab:

a. Operator's cone of visibility, including mirrors for viewing drive wheels and apron.
b. Control panel location and functional layout.
c. View panels.
d. Safety devices.
e. Aircraft interface.
f. Modifications necessary for proper connection with required aircraft types including auto-leveling devices.
g. Operating instructions placard.
h. Cab doors.
i. VDGS controller location

6. Fixed Walkway:

a. Structural calculations sealed by a professional engineer licensed in the State of Florida.
b. Design of structure to support fixed walkway.

7. Aesthetics and Safety Markings:

   a. Color and finish, exterior.
   b. Safety markings and labels.
   c. Signage and plaques (interior).

8. Electrical, Mechanical, Structural:

   a. Certifications of Compliance with all listed Design and Construction Standards.
   b. Electrical power calculations that shall be signed and sealed by a professional engineer legally licensed in the State of Florida.
   c. Electrical power and control schematic diagrams.
   d. Hydraulic schematics.
   e. Interface requirements for foundations and building supplied utilities. Provide exact location of electrical power and communications J-boxes.
   f. Structural drawings including all pertinent calculations which shall be signed and sealed by a professional engineer licensed in the State of Florida.
   g. The bridge manufacturer shall provide the Owner's Authorized Representative (OAR) with actual foundation loading data sheets for each type of bridge provided based on load requirements specified in the "Structural Design and Support Elements" Article in PART 2 of this SECTION.

9. Confirmation of aircraft parking plan and PBB slopes.

10. Certificates of compliance with NFPA 415 from a certified testing company located in the continental United States. The manufacturer shall also provide affidavits attesting to the passenger boarding bridge's compliance with NFPA 415. NFPA Certificate of Compliance, and all the supporting test results, and the certificates must be submitted with the bid documents.

11. Notarized certifications that all electrical, mechanical, and hydraulic designs, components, and installations meet the requirements prescribed in this specification.

B. Spare Parts: Submit list of recommended spare parts, prices and sources within 60 calendar days after the date of the Notice to Proceed.

C. Manuals:

1. Not less than 30 days prior to acceptance inspections, supply three (3) copies of technical manuals for each passenger boarding bridge furnished under this Contract. Manuals shall not be generic in nature and shall reflect the exact construction of each bridge furnished. Non-applicable items and drawings shall not be included in the manuals. Manuals may have descriptive type photographs. Pages shall have reinforced edges. Manuals shall be compact in size and bound. Manufacturer shall provide all listed manual information on 1 copy of CD-ROM disk.

2. The technical manuals shall contain the following information:

a. Description and operation of all systems and components.
b. Electrical drawings specific for each bridge furnished. Provide one set of bound, laminated electrical drawings for each bridge, to be placed in the control console.
c. Maintenance instructions including troubleshooting/diagnostics guidelines.
d. Overhaul instructions.
e. List of parts and part numbers.
f. Illustrated parts list of all components.
g. Recommended spare parts list and source.
h. Complete and detailed Preventive Maintenance Program for each type of boarding bridge furnished under this Contract.
i. Diagrams that show the interconnections with 400 Hz Power and PCA and PBB cooling AHU.

D. Test Reports: Submit all factory and field test reports to the Owner's Representative prior to the final inspection.

1.6 QUALITY ASSURANCE

A. Qualifications: The manufacturer and PBB installer shall provide evidence of at least ten (10) years of satisfactory experience in the design and fabrication of passenger boarding bridges specified herein.

B. Regulatory Requirements: The PBB shall be designed to conform to all applicable Federal, State and Municipal Codes and regulations as applicable to the project site in effect at the time of manufacture.

1. Structural Design and Construction Standards:

a. Code of Standard Practice for Steel Buildings and Bridges.

b. American Welding Society Standards. All welds shall exhibit adequate penetration and shall be clean and free of slag. Welds shall not be ground to improve appearance except as required for flush surfaces or where nonstructural parts are involved. On site welding and pedestal modifications shall be performed by an AWS 6G certified welder.

c. American Iron and Steel Institute Specification for the Design of Cold-Formed Steel Structural Members, Van Karmon theory and buckling studies by Peterson and Card, finite element analysis or other approved method.

d. All sheared or sharp metal edges shall be deburred or broken. All exposed metal comers shall have minimum radii in accordance with the appropriate material specification.

2. Mechanical and Hydraulic Specifications and Standards:

a. All mechanical and hydraulic components and designs shall conform to the recommendations and standards established by the Society of Automotive Engineers, Joint Industrial Conference and the American Society of Mechanical Engineers.

b. All threaded fasteners shall incorporate suitable locking devices.

3. Electrical Specifications and Standards:

a. All electrical equipment and methods of installation shall conform to the Electrical Manufacturers Association, Joint Industrial Conference, the National Electrical Code, and modifications to the NEC by the local authority having jurisdiction.

b. All electrical components utilized shall be recognized by Underwriters Laboratories in all cases where UL maintains a listing category for the devices installed.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver PBB with protective covering to prevent exposure of interior to weather, dirt and water.

B. Storage: Store PBB on site, and protect interior from weather, dirt, water, and construction debris.

C. Handling: Handle PBB according to manufacturer's written rigging and installation instructions for unloading, transporting and setting in final location.

1.8 SEQUENCING, SCHEDULING AND COORDINATION

A. Working Area: Coordinate the location of PBB staging areas, storage areas and erection areas with Airport Operations Authorities and other Contractors.

B. Bridge Foundation: Coordinate the installation of PBB with installation of PBB foundations. The PBB foundations will be completed by others.

C. Bridge Installed Equipment: Coordinate the installation with the owner-furnished 400 Hz equipment and preconditioned air system equipment and building interface electrical and communication services provided by others to ensure a complete and operational installation of the PBB. The PBB work shall include the PBB cooling units and all electrical and communication components of the PBB from the building interface outward.

1.9 MAINTENANCE

A. Extra Materials:

1. Within 60 calendar days after the date of the Notice to Proceed, furnish a list of recommended spare parts, including prices and sources.
2. Provide the following materials for each bridge at Substantial Completion:
   a. Spare fuses, minimum one (1) each size. A spare set of fuses shall be provided for all power and control types used on the bridge and turned over to GOAA maintenance.
   b. Paint touch-up kit.
   c. Aircraft closure repair kit.

B. The Contractor shall maintain an adequate inventory of all proprietary or Contractor fabricated or modified parts, especially the long lead time items considered as insurance, for routine maintenance of the unit. All stock shall be maintained, whether or not the unit is in current production for a minimum of ten (10) years from the date of the last unit manufactured. An adequate inventory of all industry standard parts shall also be available.

C. The Contractor shall provide the Owner with Service Bulletins outlining product improvement data resulting from continuing field operation experiences. Service Bulletins shall be sent to the Director of Operations**:** Orlando International Airport, 1 Jeff Fuqua Blvd, Orlando, FL 32827, United States.

1.10 OPERATOR TRAINING

A. Training Requirements:

1. The Contractor shall conduct training utilizing prepared texts, slides, actual boarding bridges, and other instructional aides as appropriate.

2. Provide a minimum 40 hours of maintenance training and 8 hours of operator training, in separate sessions, by a qualified manufacturer's representative for the models and types of boarding bridges purchased under this Contract.
   a. Training shall be conducted at the installation site and in classrooms as designated and provided by the Owner.
   b. Maintenance training shall include proper demonstration of cut-away models of critical parts, full instruction of proper maintenance and trouble-shooting, and instructions on proper use of manuals. Operator training shall include proper demonstration as well as actual use of correct bridge operations to avoid damaging the equipment by improper use of the controls.
   c. One session of each type of training shall be recorded on DVD.

3. Training shall be provided for two classes of up to 8, one class during the morning/daytime shift and one during the afternoon/evening shift at a time and place mutually agreed upon by the Contractor and the Owner. Dates shall be prior to scheduled commercial service of the boarding bridges.

4. The Owner will assign the individuals and/or companies to be trained.

5. Upon completion of training program, provide the Owner with ten (10) operating instruction brochures and ten (10) maintenance manuals for each model or type passenger boarding bridge.

1.11 WARRANTY

A. Provide special project warranty signed by the Contractor, installer and manufacturer, agreeing to replace, repair or restore defective materials and workmanship of passenger boarding bridge work during the warranty period. This warranty shall be in addition to, and not a limitation of, other rights the Owner may have against the Contractor under the Contract Documents.

   1. "Defective" is hereby defined to include, but not by way of limitation, operation, or control system failures, performance below required minimums, excessive wear, unusual deterioration or aging of materials of finishes, unsafe conditions, the need for excessive maintenance, abnormal noise or vibration, and similar unusual, unexpected, and unsatisfactory conditions.
   2. Warranty period is 24 months following the date of passenger boarding bridge final acceptance.

B. Provide coincidental product warranties where available for major components of passenger boarding bridge work. Submit with maintenance manuals.

C. The Contractor shall warrant that the PBB's and all components and accessories comply with the requirements of the Contract Documents, including approved drawings and this specification. The PBB's shall perform to the design function for a minimum period of

twenty (20) years from the date of final acceptance of each PBB by the Owner. Failures caused by normal wear and tear, Acts of God, and modifications by the Owner, which have not been approved by the manufacturer, will be excluded from the coverage in this Section.

D. The Contractor shall warrant that the PBB's and all components are new and manufactured using new materials, and are of good quality, suitable for aircraft use, and are free and clear from liens, encumbrances and title defects.

E. The Contractor shall repair or replace any warranty defect, including both parts and labor at Contractor's expense, within forty-eight (48) hours of written or notification from the Owner.

F. The firm performing warranty service shall be authorized by the Contractor and approved by the Owner. In addition, the authorized firm shall be located within a 90-mile radius of Orlando International Airport.

G. Service calls during the first year of operation (warranty period) shall require a four-hour response time from 6 a.m. to 12 a.m. midnight, seven days a week. A factory-authorized representative is required to respond to these service calls.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. JBT AeroTech.
2. ThyssenKrupp, Inc.

B. Duct work in PBB

1. UNICO Systems.
2. Per PBB manufacturer’s specific design

2.2 MATERIALS

A. Material Specifications:

Component	Applicable Standard
Structural Plate	ASTM A36
Structural Steel & Shapes	ASTM A36 or ASTM A572 Grade
Steel Hollow Structural	ASTM A500 Grade B
Steel Pipe	ASTM A53 Grade B

Steel Sheet	ASTM A570, ASTM A569 or ASTM A653
T-1 Steel	ASTMA514or ASTMA517
Hinge Pins	ASTM A311 Grade 1018 or Grade 1144 or ASTM A576 Grade
Bolts-Standard	ASTM A307
Bolts-High Strength	ASTM A325, SAE-J429 Grade 5 or 8, or ASTM A490

1. Mechanical and Hydraulic Specifications and Standards:
   a. All mechanical and hydraulic components and designs shall conform to the recommendations and standards established by the Society of Automotive Engineers (SAE), Joint Industrial Conference (JIC) and the American Society of Mechanical Engineers (ASME).
   b. All threaded fasteners shall incorporate suitable locking devices.

2. Fire Protection Standards: The bridges shall conform to the requirements of the National Fire Protection Association (NFPA) "Standards Airport Terminal Buildings, Fueling Ramps Drainage, and Loading Walkways," NFPA-415, latest edition.

3. Electrical Specifications and Standards:

   a. All electrical equipment and methods of installation shall conform to the requirements and recommendations of the American Insurance Association (AIA), National Electrical Manufacturers Association (NEMA), Joint Industrial Conference (JIC), National Electrical Code (NEC), and latest issue and modifications to the NEC by the City of Orlando.
   b. All electrical components utilized shall be recognized by Underwriters Laboratories (UL) in all cases where UL maintains a listing category for the devices installed.
   c. All equipment and controls which are exposed to the weather shall be of weatherproof type or shall be contained within weatherproof housings.
   d. Where required by the type of components installed therein and the installation environment, electrical panels or cabinets which are mounted externally to the bridge, shall be equipped with heaters or electric components to control condensation.
   e. All electrical installations shall comply with the Greater Orlando Aviation Authority Electrical Standards.

2.3 APRON DRIVE PASSENGER BOARDING BRIDGE GENERAL REQUIREMENTS

A. Design:

1. The passenger boarding bridges shall be of telescoping tunnel design. The telescoping tunnels, cab and canopy shall permit servicing of all commercial jet aircraft indicated on the attached drawing. No other bridge models, other than the ones listed, shall be acceptable.

2. Terminal floor elevation varies above the apron at the face of the building.

3. Where the passenger boarding bridge rotunda is installed at the face of the terminal building, it shall be supported entirely by its own structural support and no load or structural stress shall be transmitted to the aircraft or terminal building.

4. The vertical dimension from the passenger service lee finished floor to the top of concrete rotunda foundation and the horizontal dimension from the service level face of the building to the center of the rotunda column anchor bolt pattern shall be field verified by contractor.

5. The fixed walkway tunnels may be supported by support angles from the terminal building; support angles shall be provided and installed by the Contractor. The Contractor shall, as part of the work under this Contract, design, furnish, and erect the fixed walkways as necessary to complete the installations. The long and short fixed walkways shall meet all the structural, dimensional and finish requirements specified for apron drive PBB's. Fixed walkways shall be installed where shown on the drawings. Construction of the fixed walkway tunnel shall be substantially identical to that of the telescoping tunnels. Continuous handrails with returned ends shall be installed the full length and on both sides of the fixed walkways.

6. Reflected loads imposed on the terminal shall not exceed 5 kips applied horizontally, parallel to the face of the building.

7. Basis of Design Model Numbers and Operational Limits.

B. Operation Limits:

1. The passenger boarding bridge shall be capable of moving to any point on the terminal apron within its design operation range. The passenger boarding bridges shall be capable of having simultaneous directional movements: extension-retraction, lateral motion, vertical elevation, and cab rotation.

2. The passenger boarding bridge shall be able to reach and service all aircraft indicated on the plans without operating in a slowdown mode, including the 1U door for the A380.

C. Operating Environment: The bridges shall operate satisfactorily under ambient temperatures from -25°F to 125°F with sustained winds up to 65 mph on wet apron surfaces. The entire bridge shall be weatherproof when extended while parked to the aircraft and in the stowed position with the cab door closed. Equipment and controls exposed to the weather shall be of weatherproof type or housed in weatherproof enclosures. Electrical panels or cabinets mounted external to the bridge shall be equipped with heaters or electric components to control condensation where required by the installation environment.

D. Operating Instructions: A weatherproof and water resistant placard outlining the bridge operating instructions shall be displayed in a prominent location in the cab of each bridge in plain sight of the Operator. A qualified graphics expert shall prepare the placard and the displayed instructions.

E. Safety Requirements:

1. All equipment shall be designed to be fail-safe and all controls that regulate bridge motions (i.e., horizontal travel, vertical travel, and cab rotation) shall be of the dead-man type. Dead-man type shall mean controls that require the operator to apply constant pressure to be engaged. Once the pressure is released the control is disengaged.

2. All operating mechanisms (i.e., horizontal and vertical drive, cab rotation) shall be designed so the drive mechanism is locked when power fails or is shut off.

3. Positive mechanical stops shall be provided to prevent over-travel where any component might become disengaged from its guiding or restraining component. The positive stop shall be in addition to all limit switches provided to restrict over-travel during normal operating conditions, including drive wheel steering motions and cab rotation. This does not apply to tunnel rotation which shall have dual limit switches. Mechanical stops shall be identified and detailed on the shop drawings.

4. The operator's position in the control cab shall be designed to provide the operator adequate visibility to position the boarding bridge with the cab weather door closed. Suitable enclosures, guard rails, and other restraint devices shall be provided to protect the operator from being pitched out the open end of the cab in case of sudden stops or inadvertent movements of the bridge when operated with the door open. A handhold shall be attached to the wall on both sides of the cab weather door.

F. Maintenance Provisions:

1. Maintenance requirements shall present no special problems to personnel knowledgeable in their respective fields of hydraulics, electrical power and controls, or general mechanical assembly.

2. Install bridge components with adequate access and appropriate fastener types to permit change-out by one person. If a component's weight requires mechanical assistance to lift, the component or assembly shall be provided with lift eyes, fork lift guides, or other means of providing a mechanical advantage. Components shall be simple, rugged and easily accessible for routine maintenance, lubrication, exchange and adjustment. Electrical cabinets, hydraulic cabinets and pumps shall be located so they are always accessible to maintenance personnel standing at ground level without the use of a ladder, regardless of the vertical position of the bridge.

3. Access panels, where required to gain access to equipment or maintenance areas, shall be sized to allow necessary tools and equipment to be inserted to complete the work. The panel shall be permanently attached to the structure by hinges, and any fasteners required shall be permanently affixed to the panel.

4. Provide all product specific tools required for routine maintenance.

5. Modular components: Utilize standardized modular components that are readily available in the continental United States to provide rapid corrective measures of malfunctioning critical components. Critical bridge components shall be located to allow for ease of access and installation.

6. All hardware items required including, but not limited to, bolts, studs, nuts, washers and fasteners shall be provided in Inch-Pound unit sizes.

7. The manufacturer shall maintain an adequate inventory of all proprietary or contractor fabricated and modified parts for routine maintenance of the unit. All stock shall be maintained, whether or not the unit is in current production, for a minimum of ten (10) years from date of the last unit supplied.

8. All mechanical and electrical systems shall be protected from potential damage resulting from climatic conditions, falling objects or collision with aircraft service equipment and other moving vehicles. Wheel bogie safety hoop is not required.

G. Power and Communication Characteristics:

1. The apron drive passenger boarding bridge shall operate on a 480 volt, 3 phase, 60 Hz, 60 Amp circuit, with ground and neutral. A minimum of four spare conductors shall be included in the bridge control circuitry for possible future additions or changes to the control system.

2. The power supplies for the electrical receptacles and lighting shall be supplied from separate sources from the building. The receptacles shall be designed for two separate circuits equally distributed through the passenger boarding bridge interior and exterior. Power sources for the receptacles shall alternate as much as possible.

3. Provide transformers and circuit breakers as required to transform the 480 volt, 3 phase power for the bridge drive to 120 / 208 volt or 120 / 240-volt power for the bridge lighting and other power distribution and controls on the bridge.

4. All exterior electrical components shall be housed in weather-tight and corrosion resistant enclosures conforming to NEMA 4X stainless steel.

5. Provide sufficient cable lengths to reach the panel board or disconnect switches mounted on the face of the terminal wall at the apron level.

6. Provide strain relief devices on all unsupported cables.

7. Provide cabling for the following across each bridge: Bridge drive, bridge controls, 400 Hz frequency converter, bridge lights, VOIP telephone and controls, preconditioned air system, and bridge sign light. Cables shall be flexible copper. Plastic tie-wraps are not allowed on the project. The Contractor shall use Adel clamps for all cable attachment and bundling. Refer to the Utilities section within this specification for further information.

8. Comply with specification section 27 10 00 for all voice/data communications cabling and specification 28 23 00 for security camera connectivity.

a. Cables in the PBB shall be outside plant (OSP) rated.

b. Furnish and install six (6) OSP-rated Category 6 cables with overall foil shield (F/UTP). Refer to Utilities section within this document for connected devices.
c. Voice/data communications cabling shall not share raceway with current-carrying electrical conductors.
d. Voice/Data communications cabling shall be installed as part of PBB factory fabrication.

9. The control cables for the air handling units shall be installed into the bridge wiring during bridge factory fabrication. Cables for the temperature sensor as well as the cable for the air handling unit pushbutton control shall be provided and installed by the passenger boarding bridge manufacturer for installation and incorporation by the passenger boarding bridge. Flush mounted 2"x 4" junction boxes shall be installed in the PBB cab for the cabin temperature sensor (“Occupied/Unoccupied" switch and the "On/Off” switch). The cabin temperature sensor bypass switch and the bypass potentiometer shall be installed in the PBB control panel. Bypass switch shall be key operated. Provide 26 keys.

10. Rotunda Column Grounding: Provide a grounding stud on the rotunda base plate and attach to new or existing grounding system rod in accordance with NEC and local codes. Rotunda base anchor bolts are not ground rods and shall not be considered as such.

11. Electrical Components:

a. General: All electrical equipment and components shall be manufactured in Inch-Pound units and conform to recommendations and standards listed in the Quality Assurance Article.
b. Electrical Junctions: All electrical junction points and connections within the boarding bridge shall be made directly to terminal strips, no splices are allowed.
(1) Power cables shall be hardwired from the passenger boarding bridge directly to a distribution panel mounted at the terminal.
(2) Electrical or communication service conduit shall not be permitted on the exterior sides of the passenger boarding bridge.
(3) All cables and wiring shall be installed in cable carrying devices approved by the Owner’s Authorized Representative (OAR).
(4) All electrical switch and receptacle device plate covers shall be stainless steel and shall match the device configurations, and on exposed wiring shall exactly fit the outlet box dimensions.
c. All electrical circuitry shall be successfully tested before the unit leaves the manufacturer's plant.
d. Primary Power: The main primary power "ON" indicator light shall be located on the operator's control panel adjacent to the power "ON/OFF" control switch.

e. Anti-Chafing Devices: Whenever electrical cables are required to slide or move, anti-chafing devices shall be provided. Acceptable anti-chafing devices include grommets, flexible sleeves and jackets, and other similar approved devices.

f. Identify all cables with wire/cable identification bands on both ends. Bands shall be pre-numbered plastic coated style or type-on style with clear plastic self-adhesive cover flap, numbered to show circuit identification numbers indicated on shop drawings.

g. All J-boxes shall be labeled with engraved placards to indicate usage (i.e., 400Hz, PCA, Bridge Power).

h. Breakers in the raceways or J-box shall be re-settable from a locked box located on the side of the bridge, accessible from the service stairs and labeled appropriately.

12. Electrical Control Elements:

a. Primary power for the PBB will be supplied from the Terminal Building by a 480/277 volt, three phase, 60 Hz, 200 amp or 400-amp distribution panel with circuit breaker mounted on the exterior of the building. Transformers shall be supplied and installed by the Contractor. Power for the PBB shall be separately supplied from breakers within the panel through rotunda mounted disconnects. Include a separate disconnect switch for each service at the rotunda and provide separate power cabling from the rotunda to the cab for bridge power.

b. The electrical disconnect panel and transformer shall adapt the specified terminal power to the PBB's electrical requirements, shall be provided and installed by the Contractor, and shall be mounted on the rotunda support column.

c. The transformer and separate circuit breakers for lighting and control power shall be mounted in the power control panel provided by the Contractor.

d. It shall be the responsibility of the Contractor to advise the Owner concerning the primary power requirements.

e. In case of power failure, power to energize the PBB shall be available on a manual selective basis as determined by the Owner’s operational procedures. This emergency power supply is selected via manual switches inside the terminal building.

f. The Contractor shall check and verify the quality of the PBB's power supply and its suitability for use with solid state equipment, or other system components that are sensitive to the quality of power supply.

g. The PBB electrical/electronic components and systems shall be designed to operate in the lightning environment of the Orlando area.

h. PBB's utilizing solid state equipment or other system components sensitive to the quality of the power supply shall be provided with surge

protection which shall protect the fastest logic circuits and loads, even if destroyed, providing protection for all modes (normal, common, metallic, transverse or longitudinal). The surge protector shall be located in the equipment cabinet and the Contractor shall provide a new ground, if needed for the system.

H. Mechanical Characteristics:

1. Mechanical and Hydraulic Design and Components:
   a. Only standard components readily available in the continental United States, manufactured in Inch-Pound standard units and conforming to recommendations and standards listed in the Quality Assurance Article shall be used.
   b. All operating mechanical and hydraulic components shall be assembled and tested before the unit leaves the manufacturer's plant. The Owner's Authorized Representative (OAR) may witness testing.
   c. Hydraulic cylinders shall be designed for seal replacement by maintenance technicians.
   d. Drip pans shall be provided under all hydraulic components to prevent hydraulic fluid from dripping on the pavement.

2.4 PERFORMANCE REQUIREMENTS

A. Aircraft: Unless otherwise directed by Owner's Authorized Representative (OAR), the boarding bridge shall be capable of accommodating the first and, if applicable, second forward door of the aircraft as shown on the drawings. The telescoping tunnel shall permit servicing of all commercial jet aircraft as indicated on the drawings.

1. Maximum height above the apron at cab floor level: 25'-0".
2. Minimum height above the apron at cab floor level: 12'-0".

B. Telescoping Tunnel Slope: Maximum slope shall be 8.33% (1:12) measured from the terminal rotunda center point to the center point of the adjustable cab floor (except at the transition ramps), for each aircraft type serviced.

C. Cab Rotation: The cab shall be designed to rotate a total of 125° (90°-95° counterclockwise and 30°-35° clockwise from center) at a maximum speed of 145° per minute in either direction.

D. Bridge Rotation: The rotunda shall permit the entire unit to rotate 175° (87.5° clockwise and 87.5° counterclockwise).

E. Drive Wheel Rotation: Steer angle shall be 180° in place and in motion. Steer speed shall be between 9° and 14° per second.

F. Vertical Lift Speed: 2.5 feet per minute (fpm) to 4 fpm as measured at the cab spacer.

G. Drive Speed: The drive system shall permit the unit to extend/retract and rotate to any point within its operating envelope at a variable speed between 0 and 90 fpm.

H. Deceleration: The horizontal drive system shall include a decelerator device to reduce or eliminate shocks when approaching maximum extension, or when horizontal travel is stopped or reversed suddenly, for protection of the equipment and passenger boarding bridge operator.

2.5 STRUCTURAL DESIGN AND SUPPORT ELEMENTS

A. Loads: In addition to the dead loads and dynamic effects caused by movement, the entire passenger boarding bridge shall support the following minimum loads, unless the governing building code prescribes more severe requirements. These loads may be applied in total or in part, singularly or simultaneously. The design shall be based on the combination that imposes the most adverse loading.

1. Dead loads shall be determined by the weight of the structural system and any fixed materials (partitions, ceilings, etc.)

2. Live loads (Extended or Retracted): FLOORS 40 lb. per sq. ft. ROOFS 25 lb. per sq. ft., 200 pounds concentrated load anywhere in the roof.

3. Wind loads: Per ASCE-7-10, V=170 mph for Category IV buildings. Wind pressures on the structure shall be determined in accordance with ASCE 7-10 Sections 27.3.2 and 27.4.1 for Main Wind Resisting Systems and in accordance with ASCE 7-10 Sections 30.3.2 and 30.4.2 for components and cladding.

4. Equipment minimum loads (approximate):

   a. PCA AHU at rotunda end: 3,500 lbs.
   b. 400 Hz 90 KVA Power Unit: 2,750 lbs.
   c. 400 Hz 180 KVA Power Unit: 2,750 lbs.
   d. 400 Hz Cable Hoist: 600 lbs.
   e. PBB air handling unit: 1500 lbs.
   f. Duct work for air systems;

5. The structural design shall provide sufficient torsion rigidity to minimize sway when the boarding bridge is brought to a gradual stop.

6. All mechanisms for actuating, guiding and restraining the boarding bridge and its components shall be designed to minimize the noise, deflection, and vibration apparent to passengers. No operating vibrations or loads shall be transmitted to the terminal building.

7. Fixed Ground Services Trunk: The passenger boarding bridge shall be structurally capable of supporting installation of a fixed ground services trunk to carry preconditioned air ducts and related components. The total combined weight for all systems will not exceed forty (40) pounds per linear foot. These systems may be installed on the side or underneath the passenger boarding bridge. The Contractor shall permit the PCA contractor to install the PCA system on the PBBs.

8. The Contractor shall verify the structural suitability of the design of the PBB rotunda foundation. This verification shall be based on the information received from the foundation's structural engineer and based on actual field measurements. The Contractor shall advise the Owner's representative of any deficiencies or conflicts prior to beginning the fabrication of the PBBs.

9. The Contractor shall provide integral unistrut mounting for exterior Authority or Airline signage on the exterior of each side of the end section of the PBB assembly, providing a nominal 36” x 36” mounting frame for signage to be installed by others. The unistrut shall be 2” square in section and painted to match the exterior of the bridge surface.

2.6 BRIDGE ASSEMBLY ELEMENTS

A. Rotunda Assembly:

1. Corridor:

a. The rotunda entry corridor shall be a fixed rectangular tunnel at a constant height that connects the terminal building or fixed walkway with the rotunda.
b. The rotunda entry corridor shall be cantilevered from the rotunda column to the terminal building face or the mating frame of the fixed walkway.
c. Provide flashing to create a weather-tight connection between the rotunda entry corridor and the terminal building or fixed walkway. Flashing shall be sloped so as not to trap or pond water. Flashing shall also be installed on the interior. Flashing shall be continuous to provide a weather tight seal around the entire periphery between the bridge and the building, and to allow independent thermal movement of building structure, and shall meet the requirement of the NFPA 415, current edition.

2. Rotunda:

   a. The rotunda shall be a cylindrical structure supported on a tubular column. The rotunda floor shall remain level at all positions and shall be installed at the same elevation as the terminal.
   b. Flap type seals (dual) shall be provided for complete weather tightness between the rotunda and the hinged telescoping tunnels.
   c. Rotunda side curtain shall be galvanized steel and provided with adjustable tensioning devices, positive tracking system, and interior weather seals. Covers shall be full length with galvanized or stainless steel hinged access panel to allow access to curtain idled barrel grease fittings.
   d. Provide interior metal flashing to allow bridge movement.
   e. Provide flashing to create a weather-tight connection between the rotunda entry corridor and the terminal. Flashing shall be sloped so as not to trap or pond water. Flashing shall also be installed on the interior. Flashing shall be continuous to provide a weather tight seal around the entire periphery between the bridge and the building, and to allow independent thermal movement of building structure, and shall meet the requirement of the NFPA 415, current edition.
   f. Terminal Door Threshold: Install a threshold at the terminal door/boarding bridge interface that allows for bridge movement. The threshold shall be aluminum diamond plate.

3. Support Column: The rotunda column shall not be anchored or secured to the terminal building, nor shall it transmit any live or dead loads or vibrations to the terminal building. An industry standard #7, 8-anchor bolt foundation pattern or 16 bolt pattern shall be used.

B. Telescoping Tunnels:

1. Telescoping tunnels shall be rectangular in cross-section, constructed of 14-gauge corrugated or smooth sided metal panels and hinged at the rotunda end for vertical motion. Minimum inside dimensions of the telescoping tunnels, not including handrails, shall be:

   a. Minimum Interior Width: 4’-10”
   b. Minimum Interior Height: 6’-10”
   c. Minimum Transition Ramp Width: 4’-8”

2. Where telescoping sections overlap, low angle transition ramps shall be provided to accommodate the difference in elevation. The inner tunnel transition ramp shall be hinged and slope shall be less than 3° relative to the tunnel centerline slope. Means shall be provided to adjust and maintain the ramp lip clearance to preclude flooring wear. Where the design permits the ramp lip to ride the flooring, it shall be sheathed in a smooth Teflon or similar low friction material to minimize wear.

3. Provide flat roof tunnel or method to create a flat roof tunnel with adequate provisions for water to run off.

4. Design the telescoping tunnels and all other elements of the structure to resist the accumulation of water at low points and pockets in the structure. Drain holes shall be provided where necessary to drain collection points in any operating height. Drains from internal gutters shall be carried clear of the structure and shall be sized to prevent blockage by accumulated debris. Install yellow safety tape in all gutters.

5. Provide mechanical stops with elastomeric bumpers to prevent over-travel in the event of limit switch failure.

6. Maintain clearance between the telescoping tunnels such that no soiling or wear of the interior surfaces occurs as the result of movement.

7. Utilize flap-type seals (dual) between the individual tunnel assemblies to provide a weather tight seal and to prevent the entrance of fire and/or smoke in the event of an apron fire. Exterior seals shall utilize EPDM rubber and ALFA fire material.

8. The telescoping tunnels shall be equipped with an exterior pantograph style electrical cable conveyance system mounted on either side of the passenger boarding bridge. This system must be accessible to maintenance personnel for inspection. Plastic tie-wraps are not allowed on the project. The Contractor shall use Adel clamps for all cable attachment and bundling.

9. Provide safety cables (retractable) installed on top of bridge for service mechanic to connect with the safety harness.

C. Fixed Walkways:

1. Fixed walkways shall be of similar construction to that of the telescoping tunnels.
2. Minimum inside dimensions of the fixed walkway, not including handrails, shall be:

   a. Minimum Height: 7’-7”
   b. Minimum Width: 5'-7"

3. Fixed walkways shall be supported by and cantilevered from the rotunda column, except where support columns are indicated on the drawings.

4. Fixed walkways shall be anchored or secured to the terminal building face by structural steel supports angles designed and provided by the Contractor.

D. Aircraft Cab:

1. The cab shall be equipped with a forward facing operator control station located behind a window to permit the operator full view of the aircraft contact area. Additional visibility shall be provided through windows on the left side of the control station.

2. Cab roll-up side curtains shall be galvanized or stainless steel. The left and right curtains shall be equipped with interior weather seals and shall be interchangeable. The exterior metal curtain covers shall be full length, hinged and galvanized or stainless steel.

3. Weather door: Cab shall be equipped with half glass "French" style doors installed to seal the interior from outside weather conditions when the doors are closed. The minimum opening width shall be 43-inches and minimum height shall be 7'-1". Operations of the PBB shall be possible without opening the door.

4. The cab shall be rotated by a gear motor and chain drive operating on the circumference of the fixed circular floor section of the PBB cab. Adjustable limit switches and fixed physical stops shall control the limits of rotation.

5. Articulating Cab Floor: The aircraft end of the cab shall be provided with an automatic level device when the cab is rotated at an angle up to 95° off the centerline of the bridge tunnels.

   a. The articulating cab floor shall level automatically and shall be equipped with a manual override control switch. The floor shall be capable of providing a level surface adjacent to the aircraft doorsill for passenger boarding bridge slopes from -10% to +10%.
   b. No portion of the cab floor shall exceed 8.33% slope in the direction of expected passenger traffic.
   c. The system shall include a double hinge floor. The maximum slope of this floor shall be limited to +/- 6.5° (11.4%).

6. Spacer: Provide a spacer spanning the full outside width of the boarding bridge cab opening, along the front edge of the cab floor at the point of contact with the aircraft.

   a. Spacer installation and material shall not mark the aircraft skin, and shall prevent any damage or abrasion of the aircraft skin when the bridge is in contact with the aircraft.
   b. The spacer shall provide bodily support when stepped upon, and shall have a Shore A Durometer hardness of 70 +/- 5 when measured in accordance with ASTM D2240.
   c. The spacer material shall be an EPDM, or other suitable polymer, compounded to meet the fireproofing requirements of NFPA 415.

d. Passenger boarding bridge motion control or limit devices mounted on the spacer shall be located at the extreme outboard ends or continuously across the spacer's face along its centerline.

e. Provide Safety Track or 3M anti-skid on C-channel between the cab floor and spacer.

f. No metal trim or structural element shall be capable of contacting the aircraft fuselage outside the canopy padding and/or spacer.

g. All bridges shall be provided to accommodate the door of all aircraft indicated in the gate schedule included and as shown on the drawings. Provide cutout in the cab spacer to miss the B737 pitot tube.

7. VDGS Operator Panel: Install operator panel as furnished by Division 27 VDGS provider. Refer to specification section 27 10 20 for additional information. Refer to Utilities paragraph within this specification for connectivity requirements.

E. Aircraft Closure (Canopy):

1. The aircraft end of the cab shall be equipped with an adjustable closure with folded accordion bellows to make a weather-tight seal against the aircraft. Canopy frame shall be seven bow system. Provide inner liner curtain that covers the canopy frame members.

2. The closure shall be able to enclose both the open aircraft door and doorway of all aircraft indicated at each gate.

3. The entire Aircraft Closure shall be designed to be water-resistant, withstand weathering, remain elastic and flexible between -25°F and 125°F, be tear-resistant, and meet fire resistance requirements of NFPA 415. The aircraft closure color shall be gray.

4. Each side of the canopy arms should independently seal to conform to critical aircraft contours to provide a weather-tight seal. The mechanism shall be designed to preclude excessive pressure on the aircraft fuselage.

5. Cushion pad seals shall be provided at the point of contact between the canopy and aircraft fuselage to prevent denting and/or scratching of the aircraft skin or cabin and cockpit windows. This includes damage to rain diverters or troughs that may be located over the doors. The pads shall be reduced in thickness to account for Pitot tubes. The seals that contact the aircraft shall be segmented and attached to the main closure assembly by Velcro-type fastener strips.

6. Canopy supports or stiffening rods shall be thoroughly padded to prevent contact with the aircraft and protect canopy material when in its retracted position. The padding shall be firmly attached in such a manner that it will not slip, turn, twist, or distort from repeated usage. Allow replacement of the padding sides and top, and any inserts in sections, without replacing the entire canopy.

7. Changes in the position of the aircraft and/or passenger boarding bridge while the canopy is in contact with the fuselage shall not cause excessive loads to be exerted on the aircraft skin. Pressure exerted by closure against the aircraft fuselage shall not exceed 2 psig. Dependence upon the automatic leveling device to prevent such an occurrence is not acceptable.

8. Any chains, cables, or electrical wire that penetrates the floor or wall structure shall have adequate clearance, be protected, and securely fastened.

9. Cab seal shall be resilient bellows type. Tarpaulin types are not acceptable.

10. The canopy, when in its retracted position, shall be protected by a hood or other device to prevent water from laying in the folds of the canopy material when the bridge is not in use. Exterior liner shall include a third strap made from the same material and size as the existing end straps at center of top canopy liner, or other suitable method to prevent water ponding.

F. Service Assembly:

1. Provide a service door, stair and landing located on the right side of the cab. Door shall open outward.

2. Service door: The service door shall be hollow core, steel construction and shall meet or exceed a 3/4-hour fire rating. It shall be of a standard size with nominal dimensions of 2'-6" x 6'-8" with half wire mesh upper window.

   a. The door shall be provided with a Simplex Lock Set model # L1000 with five button combination lock with interior push plate and exterior pull handle and plate. If a key is required for the removal of the Lock Set, all lock cores shall be keyed the same.
   b. Provide a 30" x 28" stainless steel kick plate on both sides of the door.
   c. The door hardware shall be heavy duty industrial-type (using zinc plated or stainless steel standard U.S. hinges and finish hardware), and it shall be provided with an automatic heavy duty door closer installed on inside of the door.
   d. A door stop shall be provided to prevent damage to the passage set and/or door. Provide a latch to hold door in open position located on the second railing up from the floor.
   e. The door shall be constructed so the door and its components can be removed and reset or replaced for maintenance.

3. Service Platform: The service platform shall be constructed of open mesh (gripstrut) steel grating equipped with tubular steel handrails on the outside

perimeter in accordance with OSHA Standards. Both bridges shall be fitted with an access ladder with safety cage to the cab roof, accessible from the service landing platform. Cab roof handrails shall be included with the access ladder. All steel material shall have galvanized dipped finish. Platform and access ladder is required even if roof access is not required for regular maintenance. All PBB's shall be equipped with stainless steel roof tie-off cables that run from the cab roof to the terminal for tying off to when working on roof.

4. A photoelectric operated weatherproof light shall be provided above the landing. A LED fixture installed in such a manner as to optimally illuminate the stairway and landing when actuated by a photoelectric switch.

5. Service Stairs: The service stair assembly shall be galvanized steel and equipped with equal self-adjusting risers with open mesh steel treads (gripstrut) and supported at the apron on minimum 6-inch diameter wheels.

   a. The wheels shall have solid rubber tires designed to operate on concrete or asphalt pavement in elevated temperature conditions.
   b. All steps shall have an equal rise, with a tread width of 28 inches and a minimum depth of 9-1/2 inches.
   c. Both sides of the stair shall be equipped with tubular galvanized steel handrails of proper height to comply with applicable building codes and OSHA Standards.
   d. Clear width between handrails shall be a minimum of 31 inches.
   e. The service stair shall be fully usable at all boarding bridge elevations and positions.

6. Baggage Chute

   a. Baggage Slide - Provide stainless steel NOVA slide passenger bridge baggage chute or approved equal, mounted on service stair assembly. Provide baggage chutes on all passenger boarding bridges. The following is the minimum requirement for materials, devices and mounting criteria for baggage chutes.

      (1) Stainless steel trough (20-gage) approximately 26 inches wide by 16.5-inches height with a molded fiberglass 90° radius top section. The overall length shall match the service stair length of the passenger boarding bridge.
      (2) The trough shall be supported by a rigid steel framework and be self-supporting without intermediate supports attached to the service stairs.
      (3) The chute shall only be mounted to the primary support beam at the forward edge of the stair platform.
      (4) The opening in the stair railing into the baggage chute slide shall be a minimum of 30" wide.

(5) The chute shall be supported by at least two (2) hard rubber caster wheels mounted to the bottom of the chute frame.

(6) A 1,500-pound capacity electric powered winch shall be installed on the top of the chute with theft proof hardware.

(7) All hardware associated with the attachment to the PBB.

(8) Any wiring associated with the winch motor.

b. Baggage Slide Alternative – An alternative to a baggage slide like motorized baggage conveyor will be also be considered. Such device may be attached to the service stairs with an appropriate fastening system or retract to a folded position or may be attached to the bridge cab and be retractable into an upright stowed position.

(1) Baggage conveyor shall have the same minimum width as required of baggage slides and must be supported on the bottom end by casters or wheels and automatically adjust to move with the PBB both horizontally and vertically.

(2) Baggage conveyor shall be adjustable so that baggage personnel may raise or lower the conveyor rubber belt surface.

(3) Baggage conveyor shall be capable of handling up to 500 lbs. of baggage or motorized equipment.

(4) Baggage shall have controls at the both ends of the unit to allow baggage personnel to turn the device on or off, reverse the direction of the belt, and also have an 'E-Stop' function to stop the device in case of an emergency.

(5) Baggage conveyor shall be powered from the PBB and operate on 120 VAC power.

(6) Baggage conveyor shall have a timer or time out function that will detect inactivity or provide for timed operation and turn off power to the unit accordingly.

(7) Baggage conveyor should have a canopy or similar protective system to protect baggage from the elements.

(8) Baggage conveyor shall be designed for ease of maintenance from the ramp level for ease of repair, replacement, adjustment or inspection of belts, rollers, idler arms, and any other mechanical, electronic or electrical components.

7. Service/maintenance stair and cab roof handrails shall be provided for OSHA- approved access to service equipment.

G. Drive Column: The drive systems shall be either hydraulic or electro-mechanical and meet the criteria listed below:

1. Vertical Drive- Hydraulic:

a. The hydraulic pump and motor drive for vertical travel of the bridge shall be an integral part of the drive wheel assembly, accommodate and weight of the bridge, and operate smoothly and quietly.

b. The hydraulic power system shall permit simultaneous vertical travel and horizontal travel and steering.

c. The hydraulic power system shall utilize a heavy-duty oil-based hydraulic fluid with corrosion inhibitors.

d. The operating temperature environment shall determine hydraulic oil viscosity. Special synthetic hydraulic oils having a low viscosity index shall be supplied for extremely low-temperature environments. Coordinate hydraulic oil requirements with the manufacturer based on the project location environment.

e. All hydraulic components shall be designed for maximum corrosion resistance and compatibility with the hydraulic fluid used.

f. Vertical travel shall occur by driving two hydraulic cylinders to the desired height by means of solenoid-operated hydraulic valves.

g. Hydraulic cylinder rods shall be chrome plated. The hydraulic cylinders shall be equipped with a vertical drive pump brake (pilot-operated check valves) which automatically releases when hydraulic pump(s) are in operation and vertical motion, up or down, is signaled from the operator's console or from the auto-level circuit.

h. Vertical rate of travel shall be adjustable from 2.0 to 3.6 feet per minute.

i. Pilot-operated check valves located at hydraulic cylinders shall prevent bridge downward movement in the event of a total hydraulic system failure, including rupture of any hydraulic hose in the system.

j. Each drive column shall be designed to support the full weight of the bridge if the other should fail.

k. Provide manual vent valves at the high points of the vertical drive system to bleed air from the hydraulic system.

2. Vertical Drive- Electro-Mechanical:

a. The bridge shall be moved vertically by means of two re-circulating ball bearing screw assemblies. Each assembly shall be independent of the other, with individual motors. Each assembly shall be capable of supporting the passenger boarding bridge under full design load. The lifting mechanism shall hold its position at any elevation within the travel range with or without power supplied.

b. The ball screw ball nut shall be equipped with wiper brushes to remove grit or dirt from screw threads and a self-locking acme-type thread which will prevent unit collapse in the event of ball nut failure.

c. The vertical drive motors shall be AC induction motors with integral reducer and brake. The brakes shall be spring-applied and electrically released only when signal is received from the operator's console or the auto-level system.

d. The brakes shall hold securely at all elevations, without creeping, whether the bridge is in operation or not.

e. A fault detector shall sense differential motion of the ball screw assemblies. The fault detector circuit shall shut down the electrical power to the vertical drive motors and set the brakes independently of the operator if a fault is detected.

f. A tapered collar that prevents the screw from disengaging the ball nut shall be attached to the ball screw's lower end.

g. Boarding bridge vertical rate of travel shall be a constant speed.

h. Reference stripes shall be painted or mechanically fastened on the inner tube(s) to indicate column travel limits, both high and low.

i. Backup emergency plunger-type limit switches shall be provided in the vertical circuit, for both high and low limits.

j. Inspection holes in each column tube shall be provided to allow baroscopic inspection of the ball screw surface. All holes shall be aligned in inner and outer column tubes. Cover plates shall be provided in outer tube.

3. Horizontal Drive - Electro-Mechanical:

a. A variable speed electro-mechanical drive system shall provide horizontal travel of the passenger boarding bridge. The drive shall be two-wheeled with solid rubber tires.

b. An AC gear motor shall independently drive each wheel. The gear motors shall be provided with integral brakes. Solid-state variable frequency motor controllers shall drive the AC motors. The controller shall provide built-in diagnostics to assist in trouble shooting.

c. A regenerative braking system shall allow the bridge to come to a smooth, controlled stops. Integral electrically-released spring actuated brakes shall be provided with each drive motor and shall lock the bridge in place whenever electrical power is cut off, either by moving the control lever to the neutral position or if power fails.

d. Provide a manual override to release drive wheel brakes to permit towing the passenger boarding bridge into or out of position on the apron in case of power failure. The override system shall be mechanically interlocked to preclude normal operation with the brakes locked out.

e. Connection lugs shall be provided to allow the bridges to be towed in the event of power failures.

f. Provide positive identification for both the front and backsides of the wheel bogie. Such identification shall be clearly readable by the

operator while operating the control panel. Include instrumentation (a wheel bogey position indicator) on the control console.

4. Wheels and Tires:

a. Passenger boarding bridge wheels and tires shall be of sufficient width and surface quality to preclude damage to apron pavement and shall be designed to operate on Portland cement or asphalt pavement.

b. The tires shall be solid rubber type suitable for use by passenger boarding bridges. Tires shall be manufactured of a rubber compound that will not chip or fray at the edges, and not be affected or damaged due to contact with oil, lubricating and hydraulic fluids, and/or fuels from aircraft and servicing equipment, including Skydrol hydraulic fluid.

c. Each tire shall have a wheel loading, under full, dead and live loading, not to exceed 300 psi. Only the wheel to axle hub bolts/nuts shall be able to be removed while the wheel is mounted on the wheel bogie.

d. The wheel and tire changing procedures shall be specified in the Maintenance Manual.

H. Controls: All operations of the Passenger Boarding Bridge shall be controlled by PLC manufactured by Allen - Bradley.

1. Control Station General Requirements:

a. Locate all passenger boarding bridge operator controls on the bridge cab control console in a position that provides maximum operator visibility as the bridge is maneuvered near the aircraft with the cab weather door closed.

b. Locate the operator control station to provide adequate space for the operator and maintenance access to the electrical control components as required by voltage classification in the National Electrical Code.

2. Control Console: The control console shall be located in the operator compartment and protected from the outside environment. The control console shall be tamper and theft proof. Provide two door locks, top and bottom, and hold open gas shock. Provide hinged console face and support rod.

a. Provide hinged Lexan cover to protect the console when not in use. Cover shall be able to support itself as desk. Provide support legs screwed into place.

b. Provide lighted and labeled controls for all switches and indicators. Console shall have a lamp test button to test all console lamps and alarms. Lamp test shall be enabled in the

operator switch "OFF" position only and shall supply 110 volts or 24VDC to console lamps. All console lamps shall be LED.

c. Controls: All passenger boarding bridge motion controls shall be the momentary contact (dead man) type. All motion controls shall be located to be relative to the function of the passenger boarding bridge being controlled (i.e., with raise and lower functions, the "RAISE" push button will be located above the "LOWER" push button). The control console includes the following control switches and indications. All switches shall be Cutler Hammer or Square D with engraved lens. A touch screen located on the control panel is acceptable for various secondary functions.

(1) Master Key Switch, Off/Operate/Auto (Automatic Leveling). Key shall be removable only in "OFF" or "AUTO" position.

(2) Power On (Green illuminated) (Black Button).

(3) Cab Rotate Left and Right (White illuminated) (Black Button).

(4) Canopy Up/Down Left Side (White Illuminated) (Green Button/Arrow).

(5) Canopy Up/Down Right Side (White illuminated) (Green Button/Arrow).

(6) Cab Floor in Auto On/Off (White illuminated) (Black ON Button, Red OFF Button).

(7) Cab Floor in Manual Tilt Left or Right (White illuminated).

(8) Travel Warning Bell (Blue Button).

(9) Steering Left of Right (White illuminated) (Blue Button Arrow).

(10) Forward or Reverse Spring Loaded 2-way Joystick.

(11) Spring Loaded 4-way Quad Joystick.

(12) Vertical Up or Down (White illuminated) (Blue Button/Arrow).

(13) Lamp Test (Black Button).

(14) Flood Lights On/Off (White illuminated) (Black ON Button, Red OFF Button).

(15) Manual Operated Cab Weather Door.

(16) 400 Hz Cable Hoist Deployed Light (Yellow lens illuminated).

(17) 400 Hz On Light (Red lens illuminated) (Horizontal drive interlock applied and alarm).

(18) Warning Alarm for 400Hz Failure.

(19) Warning Alarm for Auto Level Failure.

(20) Oversteer Alarm (Red lens illuminated) if oversteer is possible without use of a mechanical lock.

(21) Door Open Alarm Blank White (White illuminated).

(22) Lift Column Fault (Red illuminated).
(23) Canopy Down (Red illuminated).
(24) Auto Level On (Yellow illuminated).
(25) Auto Level Alarm (Red illuminated).
(26) Swing Limit Warning (Red illuminated).
(27) Swing Digital Readout (Black Button).
(28) Height Meter and Swing Read Meter (LED).
(29) Wheel Position Indicator, showing arrow and wheels.
(30) Emergency Stop (Red Button).
(31) Preconditioned Air in use (Green).
(32) Pair cabin temperature by-pass switch.
(33) PCAir cabin by-pass temperature potentiometer.

d. Labeling: All switches and/or push buttons shall be labeled. Each function shall be spelled out (i.e. "Canopy", "Extend", "Retract").

e. Warning devices:

(1) Swing Limits.
(2) Slope Limits.
(3) Auto Level (Red Strobe Light- Failure Indicator).
(4) Vertical Column Fault lighted indicator/alarm on Control Console.
(5) Over steer.
(6) Warning Rotating Beacon or strobe beacon under cab when bridge is in Operation Mode only.
(7) 110-volt Travel Alarm Bell.

3. Hydraulic Manual Control System for Emergency Use: Each passenger boarding bridge which uses a hydraulic motion or lift control system shall be equipped with a manual control (dead man type) system to permit bridge operation at ground level in the event of a complete control system failure. The controls shall be located in a safe area so the operator has a clear unobstructed view of the aircraft spacer interface, and the passenger boarding bridge will not injure the operator in any way while manually maneuvering the passenger boarding bridge at ground level.

4. Interlocks:

a. General: The control system logic shall preclude damage to circuits or mechanical systems due to simultaneous contrary control signals or an otherwise unsafe control signal combination.

b. Contrary Control Signal Interlock: All boarding bridge motion shall be precluded whenever contrary control signals (i.e., extend and retract) are activated simultaneously.

c. Control Console Doors: Provide safety interlock switches on all control console doors; upper console, console face and console front door.

d. Canopy Interlock: Interlock shall prevent all forward or reverse horizontal drive operation when canopy is lowered. All passenger boarding bridge motion, except auto-leveling, shall be possible only when the canopy is in a fully retracted position. Provide for a dead man- type mechanical override to permit the retraction only in case of mechanical emergency or bridge failure with the canopy not in the fully retracted position.

e. 400 Hz Interlock: Interlock shall prevent horizontal drive operation when the 400 Hz unit is engaged, and the hoist is lowered. The control console shall be equipped with warning horn and flashing light to indicate when:

(1) 400 Hz hoist is lowered.

(2) 400 Hz cable is engaged and the unit is operating (to be independent of each other).

f. The passenger boarding bridge shall provide a dry contact interface that is interconnected by a signal provided by the PCA Unit. The horizontal drive system shall then be interlocked to preclude passenger boarding bridge movement if the PCA is in "run" operation. PBB manufacture shall coordinate this interconnection with the PCA Unit and the PBB shall provide all specified interconnections between the PBB and the PCA system.

5. Limit Switches: Electrical limit switches shall be provided on all passenger boarding bridge movement actuator systems, cab spacer and canopy system. These shall include fail-safe proximity limit switches activated near the end of horizontal and vertical travel. These switches shall de-energize their respective actuator systems when contacted.

a. Bridge extension and retraction: Provide two limit switches, one for slow down and one for stop.

b. Cab rotation: Provide limit switches to control the extremes of cab rotation.

c. Drive wheel: Provide limit switches to control over steer of drive wheels.

d. Rotunda rotation: The rotunda shall be equipped with adjustable limit switches to control the traversable area of the bridge. If the bridge activates the limit switch, all power shall be disconnected, stopping the bridge. The limit switch located on the rotunda shall only be reset locally when activated.

e. When the 400 Hz power is energized all bridge motion (except for auto leveling) shall be precluded.

f. Upper Console: Cabinet or housing for AC drive packs shall be:
   (1) Waterproof.
   (2) Equipped with a service light.
   (3) Equipped with a thermostatically controlled heat strip.

6. Building Management System (BMS) Interface: The PBB control PLC shall be connected to the building network. Refer to Utilities paragraph within this specification for connectivity requirements. Communication with the BMS shall be via the PBB control PLC manufacturer's standard communications protocol over Ethernet (example: Modbus over Ethernet). All PLC alarms and status messages shall be able to be monitored remotely via this connection. The following alarms and operational statuses specifically shall be programmed into the BMS for monitoring for each PBB:
   a. Auto Level Alarm.
   b. All Anti-Collision Alarms.
   c. PBB On.
   d. PBB in Auto.
   e. PBB general trouble Alarm.
   f. PBB in Maintenance Over Ride.
   g. Up to five additional points as requested by the owner.
7. Anti-Collision System: For a PBB that are to be used in combination with another PBB to service the same aircraft, an anti-collision system shall be provided.
   a. This system shall be of the manufacturer's standard design. The system shall use any combination of proximity detection devices or PBB position indicators.
   b. The system shall place the PBB in slow down mode when approaching the neighboring bridge. The distance required shall be as recommended by the manufacturer but in no case shall be less than 10 feet.
   c. The system shall stop the PBB before a collision occurs. The distance required shall be as recommended by the manufacturer but in no case shall allow the PBBs to contact each other even if the PBB is rocking due to momentum.

I. Automatic Leveling:

1. Passenger boarding bridge shall be equipped with an automatic leveling device. The auto-leveling system shall automatically respond to small changes in aircraft elevation that occur during aircraft loading and unloading to maintain a constant relationship between the aircraft floor and the boarding bridge floor. The auto- leveling system shall function with equal reliability for all aircraft contours.

a. The auto-leveling system shall be engaged when the master switch is positioned to "AUTO".

b. The leveling system shall not exert any stress on the boarding bridge.

c. The leveling device actuating mechanism or sensor which contacts the aircraft shall be located on the right side of the cab behind the canopy actuator covers.

d. The leveling system shall function reliably on all aircraft specified regardless of door location, fuselage contour, and aircraft door sill height and shall allow a range of adjustment of at least six inches up or down from a neutral position.

e. The auto-leveler circuit shall include an adjustable solid-state sustained travel timer. The timer shall limit the automatic leveler's continuous response in either direction to an adjustable range from 1.6 to 6 seconds. A fault condition shall be identified when the timer has tripped. Upon sensing of a fault condition, all motor power shall be disconnected, and audible and visual alarms shall be energized.

f. The circuitry shall include an audible alarm and a red warning light at the control station, and the rotunda and a red strobe light on the exterior base of the PBB in the general ramp area, which shall produce a distinctively different sound than any other on the passenger boarding bridge. These warning systems shall be automatically activated by any movement of the PBB except when in the auto level mode.

g. The orange rotating beacon shall illuminate when the key switch is in the "Operate" position.

h. When the timer circuit is interrupted, the vertical lift system shall automatically be locked in position and de-energized, and a vertical travel brake automatically engaged.

J. Lighting:

1. Exterior Lighting:

a. Service platform light shall be controlled by a photo cell mounted on the exterior of the PBB.

b. Cab exterior LED light.

c. Exterior flood lights: Weatherproof

d. Provide two (2) adjustable flood lights with safety cages having a minimum intensity of three hundred (300) watts each (LED equivalent) and located on the exterior base of the bridge-head/cab, and controlled from the control panel. An additional flood light shall illuminate the area around the drive column and be controlled by the photo cell for the service platform light.

e. Gate identification sign.

2. Interior Lighting: Provide separate lighting circuits for the PBB. Each shall be controlled independently by motion detectors located at the cab and rotunda for apron drive bridges. All receptacle device plate covers shall be stainless steel. Lights shall be placed every eight (8) feet in the boarding bridge and oriented so there will be no conflicts with the installation of the bridge cooling system ductwork.

    a. Lamps: LED.
    b. Contoller shall be provided for O°F cold weather rated applications.
    c. Tunnel: LED.
    d. Rotunda: LED.
    e. Cab: Console LED lamps

3. Emergency lighting controller shall be provided in the following locations to operate when bridge power is lost. The red power indicating light shall be located in the tunnel light fixture.

    a. Rotunda ceiling light.
    b. A-tunnel middle and end.
    c. B-tunnel middle and end.
    d. C-tunnel middle and end.
    e. Cab external light.

4. Emergency LED Lamp Power Supply: Provide self-contained battery powered inverter unit for direct mounting in designated LED fixtures. Provide unit with 120Vac input, fully automatic two rate charger, nickel-cadmium battery, automatic low voltage battery disconnect, AC "ON" pilot light, and test switch. Unit shall automatically transfer to battery supply on loss of normal AC power and operate one 4-foot LED fixture with a minimum output of 1100 lumens for 1-1/2 hours.

5. Illumination Level: Intensity of illumination will be measured at the floor.
    a. Tunnel and Cab: 25 foot-candles average.
    b. Cab lighting: Twenty (20) foot-candles. Control panel area shall have sixty (60) foot-candles. It shall be possible for the operator to turn off cab lights at the control console to eliminate glare when positioning the bridge to the aircraft during hours of darkness.

6. All lighting fixtures shall have adequate access for replacement and fixture cleaning.

7. Provide 120V, 20-amp electrical circuit with conductors terminated in a weatherproof junction box located on the underside of the cab.

8. Provide electrical circuit to extend the building lighting circuit to power a bridge mounted sign located at the cab end. Provide a 277 volt, 20-amp

circuit and conductors from the face of the terminal building under the passenger boarding bridge to the weatherproof junction box located on the underside of the cab.

9. A minimum of eight (8) spare conductors shall be provided from the rotunda to the control panel for future systems. In addition, provide and install two (2) 12-pair sheaved control cables (22-gauge wire) from a weatherproof junction box under the rotunda to weatherproof box under the cab for the PCA system, such as cabin temperature control sensor, jumbo gates wiring for the second hose damper, etc. Coordinate number, locations and routing with PCA contractor.

K. Insulation:

1. Insulation shall be provided in the walls and ceiling.

2. Insulation materials shall not be exposed to the weather or applied with glues or tape.

3. All insulation materials shall be covered with appropriate weather resistant finish material.

4. Insulation shall be installed full width of ceiling with all areas insulated. Insulation shall butt against light frame edges with separate piece over light fixture.

5. The design shall eliminate the possibility of condensation in the insulation that might cause unsightly water stains appearing on the interior finished surfaces and rust at the interface of the insulation and outer shell.

6. The use of asbestos or asbestos products as an insulation material or for any other use is not permitted.

L. Windows: Provide windows as follows:

1. Cab: Provide clear safety glass front window to permit operator at control console full view of the aircraft contact area. Provided a wire reinforced safety glass window to the left side of the control station.

2. Cab roll up side curtains: Provide two wire-reinforced glass windows in every other panel, 1/4" thick x 1-3/4" wide x 12" long. The windows shall be in the low normal positions on the right side and high normal position on the left side.

3. Service door: Equip the door with a 1/4" thick x 14-7/8" wide x 2' 5-7/8" high wire reinforced glass window.

M. Utilities:

1. The apron drive bridges telescoping tunnels shall be furnished with an under bridge cable assembly consisting of six (6) Category 6 cables from cab to rotunda as specified in **Error! Reference source not found.**. Connect from rotunda to communications enclosure provided at the exterior terminal wall. Terminate cables as specified below.
   a. Telephone: One (1) of the Category 6 cables shall be reserved for a VoIP telephone. Terminate cable in cab near console on wall. An RJ-45 outlet for the installation of telephone or intercom equipment shall be in an enclosure located on left side wall adjacent to the control console no higher than 54 inches above the floor or as dictated by ADA requirements. Telephone instrument to be furnished by the Authority.
   b. Video Surveillance Camera: One (1) of the Category 6 cables shall be reserved for the security camera. Furnish and install a 4”x4” ceiling-mounted backbox to support an Authority security camera and route security camera cable in conduit to this box. Terminate cable in an RJ-45 connector. Refer to security drawings for camera location within the PBB.
   c. VDGS Operator Station: (1) of the Category 6 cables shall be reserved for the VDGS operator station. Coordinate with the work of Division 27 to determine termination type and location.
   d. BMS Interface: One (1) of the Category 6 cables shall be reserved for the PBB control PLC connection. An RJ-45 outlet shall be installed in the PLC enclosure for connection to the PLC. Connection between the PLC and RJ-45 connector shall be via a standard Category 6 jumper cable

2. Convenience Outlets: Ground Fault Interrupter (GFI) duplex outlets (unswitched 120 volt, 1 phase, 15 amp) shall be located as follows:

   a. A and C Tunnels.
   b. Left side wall of the cab, adjacent to the operator's control console.
   c. Rotunda.
   d. Drive column wheel carriage crossbeam.

3. The apron drive bridge telescoping tunnels shall be equipped with a Pantograph style cable carrier transport system, for the 60 Hz power transmission cables to the 400 Hz frequency converter mounted under the aircraft cab, boarding bridge power PCA control cable, and preconditioned air unit power receptacle. The cable transport system shall be mounted on the exterior sides or top of the PBB. This system must be accessible to maintenance personnel for inspection.

2.7 ACCESSORIES

A. Cab Safety Chain: Provide cab safety chain installed forward of the cab doors with red plastic sleeve.

B. Mirrors: Provide two 18-inch circular convex safety mirrors with stainless steel backing. Locate on the left side of the cab to enable the operator to have full view of the apron and drive wheels and on service platform railing to allow operator to view the bottom of the service stairs from the control console.

C. Handrails: Handrails shall be Americans with Disabilities Act (ADA) compliant (1-1/4" to 1-1/2" O.D.), mounted at a height of 34" to 38" above floor surface, with a minimum clearance from the sidewall of 1-112" and with return ends. Provide handrails in the following locations:

1. A-tunnel, full length on the right side and left side.
2. Transition ramp areas, both sides of the tunnel. The handrail shall extend over the transition ramps and shall be sloped at a uniform dimension above the ramp.

D. Guardrail: Provide a guardrail of the same size and shape as the handrails located at the junction of the “A” and “B” tunnels. The guardrail is to be positioned such that it diverts people from encountering the horizontal air conditioning duct installed at the ceiling of the “A” tunnel.

E. Jack Stand: Provide one standard jack stand structure suitable to straddle and support the boarding bridge from the ground. It shall be designed to support the weight of the bridge for servicing undercarriage components, and the cab lifting mechanisms. Furnish all jack stands with hydraulic jacks (if necessary). The jack stand shall be delivered prior to substantial completion.

F. Tow Bar: Provide one tow bar designed and constructed to be stored, transported and connected to the boarding bridge undercarriage for towing of a disabled unit. Tow bar shall be configured for connection to a standard height hitch on a pickup truck.

G. Gate Sign: Provide gate sign to match the existing. Provide outdoor lighting for sign as indicated, complete with wiring and circuit over current protection and disconnect.

H. Pre-Conditioned Air and Bridge Cooling: Pre-conditioned air and bridge cooling systems shall be provided in accordance with specification section 23 90 00 – Pre-Conditioned Air Units and Specialties. Suggested mounting locations are as shown on the plans but PBB manufacturer specific standard mounting shall be acceptable. All mounting brackets and weldments required for the installation of the equipment shall be performed in the factory prior to shipment of the equipment.

I. 400 Hz Ground Power Units (GPU): 400 Hz GPUs shall be provided in accordance with specification section 26 61 00 – 400HZ Frequency Converters. Suggested mounting locations are as shown on the plans but PBB manufacturer specific standard mounting shall be acceptable. All mounting brackets and weldments

required for the installation of the equipment shall be performed in the factory prior to shipment of the equipment.

Potable Water Cabinets: Potable water cabinets shall be provided in accordance with specification section 22 37 00 – Potable Water Cabinet. The potable water cabinet shall be mounted on PBB. Suggested mounting locations are as shown on the plans but PBB manufacturer specific standard mounting shall be acceptable. All mounting brackets and weldments required for the installation of the equipment shall be performed in the factory prior to shipment of the equipment.

J. Hurricane Tie Downs:

1. The Contractor shall provide hurricane tie down requirement details and verify their location as shown on the plans in accordance with the PBB manufacturer's recommendation and adjust as necessary.

2. The PBB manufacturer shall provide a complete hurricane tie-down appurtenance kit for each PBB, including equipment and incidentals needed to tie-down the PBB in hurricane wind loads up to 150 miles per hour.

2.8 FINISHES

A. Exterior Paint System: All exterior steel surfaces shall be protected from corrosion by the following:

1. Surface Preparation: De-burr and remove all weld splatter and dingle berries, also grind excessive/rough welds smooth, and round sharp edges and comers. Contaminants (oil, grease, dirt, etc.) shall be removed from surfaces in accordance with SSPC-SPl (Solvent Cleaning) requirements and appropriate SSPC commentaries. Exterior steel surfaces shall be dry abrasive blast cleaned with garnet grit in accordance with SSPC-SP6 (Commercial Blast Cleaning) or better to obtain an angular 1-3 mils profile depth. If steel is not new or is corroded, blast to SSPC-PC 10 standard. Thoroughly clean with dry high pressure air to remove dust and grit, then mask all necessary areas before priming. The blast cleaned surface must be primed soon enough to prevent corrosion form occurring on the profile.

2. Prime Coat: Apply one coat of Sherwin-Williams chromate free High Build Epoxy Primer E65AC8/E65AC12 (or equivalent) or American Coatings Rustlock 8010 Series Epoxy-two component (or equivalent) at a dry film thickness of 12 mils to the exterior surfaces, per manufacturers' instructions in the Product Data sheet. Follow all manufacturers' handling and curing instructions.

3. Finish Coat: Apply one coat of Sherwin-Williams "POLANE H" polyurethane (or equivalent) or American Coatings WB Series Roof Mastic (or equivalent) for the roof topcoat and American Coatings SU Series (or equivalent) for all other surfaces; finish paint to a dry film thickness of 12 mils, per manufacturers' instructions in the Product Data sheet. Follow all manufacturers' handling and curing instructions. Color in accordance with table below.

4. Sealer Finish Coat: Minimum 6 mil DFT.

5. Total exterior dry film thickness: 30 mils minimum.

6. Colors and finishes shall be selected by the Owner from full color range.

7. All exterior finishes shall be warranted for a period of five (5) years for the date of Final Acceptance.

8. Approved Manufacturers:

   a. Products manufactured by Sherwin-Williams are listed in order to establish a level of quality and performance required on this project.
   b. Equivalent materials manufactured by American Coatings, Carboline or Tnemec may be submitted for approval by the Owner, providing they are of the same generic type as the specified products and meet or exceed the ASTM performance criteria of the specific projects.

B. Exposed Interior Paint System:

1. Surface Preparation: De-burr and remove all weld splatter and dingle berries, also grind excessive/rough welds smooth, and round sharp edges and comers. Contaminants (oil, grease, dirt, etc.) shall be removed from surfaces in accordance with SSPC-SPI (Solvent Cleaning) requirements and appropriate SSPC commentaries. Mechanical clean in accordance with SSPC-SP3 (Power Tool Cleaning) to remove loose scale and contaminants from the surfaces where required. The cab surface shall be dry abrasive blast cleaned with garnet grit in accordance with SSPC-SP6 (Commercial Blast Cleaning) or better to obtain an angular at 1-3 mils profile depth. If steel is not new or is corroded, blast to SSPC- PC 10 standard. Thoroughly clean with dry high pressure air to remove dust and grit. Then mask all necessary areas before priming. The blast cleaned surface must be primed soon enough to prevent corrosion form occurring on the profile.

2. Prime Coat: Apply one coat of Sherwin-Williams chromate free High Build Epoxy Primer E65AC8/E65AC12 (or equivalent) or American Coatings Rustlock 8010 Series Epoxy-two component (or equivalent) at a dry film thickness of 12 mils to the cab surfaces, per manufacturers'

instructions in the Product Data sheet. Follow all manufacturers' handling and curing instructions.

3. Finish Coat: Apply one coat of Sherwin-Williams "POLANE H" polyurethane (or equivalent) or American Coatings SU Series (or equivalent) finish paint to a dry film thickness of 12 mils, per manufacturers' instructions in the Product Data sheet. Follow all manufacturers' handling and curing instructions. Color in accordance with table below.

4. Sealer Finish Coat: Minimum 6 mil DFT.

5. Total interior dry film thickness: 30 mils minimum.

6. Colors and finishes shall be selected by the Owner from full color range.

7. Approved Manufacturers:

   a. Products manufactured by Sherwin-Williams are listed in order to establish a level of quality and performance required on this project.
   b. Equivalent materials manufactured by American Coatings, Carboline or Tnemec may be submitted for approval by the Owner, providing they are of the same generic type as the specified products and meet or exceed the ASTM performance criteria of the specific projects.

C. Non-Exposed Interior Paint System:

1. Surface Preparation: Contaminants (oil, grease, dirt, etc.) shall be removed from surfaces in accordance with SSPC-SPI (Solvent Cleaning) requirements and appropriate SSPC commentaries. The minimum surface preparation for all non- exposed interior surfaces shall be in accordance with SSPC-SP3 (Power Tool Cleaning) at 1-3 mils profile depth. Thoroughly clean with dry high pressure air to remove dust and loose scale. The mask all necessary areas before priming.

2. Primer Coat: Apply one coat of Sherwin-Williams corrosion resistant lead and chromate free, Kern AQUA 70P (or equivalent) metal primer at a dry film thickness of 4-6 mils, per manufacturers' instructions in the Product Data Sheet. Follow all manufacturers' handling and curing instructions.

3. Approved Manufacturers:

   a. Products manufactured by Sherwin-Williams are listed in order to establish a level of quality and performance required on this project.
   b. Equivalent materials manufactured by American Coatings, Carboline or Tnemec may be submitted for approval by the Owner, providing they are of the same generic type as the specified products and meet or exceed the ASTM performance criteria of the specific projects.

4. Small Miscellaneous Assemblies:

   a. Dry abrasive blast clean in accordance with SSPC-SP 6 or better or obtain a 0.5-1.5 mil profile. If steel is not new or is corroded, blast to SSPC-PC 10 standard.

   b. Apply one coat of MORTON INTL. Corvel Zinc Rich, Gray, Epoxy 3/4 Powder 13-7007 (or equivalent) heated to 350 F for 35 minutes at 4-6 mils.

D. Exterior colors and finishes shall be as follows (Owner to select color from full range of custom color chart):

1.	All PBB's to be painted with exterior colors as determined by the Owner.	
2.	Tunnels, cab, sides, underside	GOAA Pelican White
3.	Roof	White non-skid
4.	Cab curtain side covers	GOAA Pelican White
5.	Service stairs, landing & handrails	Galvanized Steel
6.	Upper lift column section, outer tubes	GOAA Pelican White
7.	Inner-tubes, lower drive column section & rotunda support column below the bearing	GOAA Pelican White
8.	Aircraft closure hood & side skirts	Grey
9.	Cab area forward of the cab doors, actuator covers and the outside door face	GOAA Pelican White

E. Interior colors and finishes shall be as follows:

1.	Wall trim	Aluminum/Black Centers
2.	Tunnel end trim	Color selected by Owner
3.	Ceiling to wall trim	Flat Black
4.	Kick plate	Flat Black
5.	B&C Tunnel Rain Gutters	Flat Black w/Yellow & Black Zebra Tape
6.	Flooring molding Aluminum	Clear Anodized
7.	Cab floor	Black Ribbed Rubber
8.	Ceilings (All) 7 ¼” galvanealed steel sheet	Aluminum (brushed) or of coiled coated Color to be selected by the Owner
9.	Rotunda & cab walls	Color to be selected by the Owner
10.	Flooring	Owner supplied and installed
11.	Interior Tunnel Walls:	

a. Interior wall treatment shall consist of 3/8-inch thick fire-rated particle board sandwiched between two high pressure laminates (Wilson Art Color Product, Nevamar, Formica or approved equal) wall panels laminated on both sides to prevent bowing, four feet on centers with aluminum trim and recessed black accent strips or 20 gauge (minimum) coiled coated galvanealed flat steel panels four feet on centers with trim finished in accordance with the specified exposed interior paint system. Provide water drain holes in the bottom J-channel.

b. The finished product shall carry a UL label and shall meet the flame spread test as listed in ASTM E84.

c. The design shall allow each panel to be removed individually.

d. Owner to select color and finish from full range of premium and custom color chart.

12. Interior Floor:

a. Tunnels floors shall be constructed of minimum 3/8-inch aluminum, 3/4- inch thick moisture resistant, fire retardant marine plywood or orientated strand board-exposure 1 made with exterior phenolic resin adhesive or smooth galvanealed steel.

b. The cab, cab bubble, and rotunda floors shall be constructed of minimum 3/8-inch aluminum.

c. Transition ramps shall be constructed of 1-1/8-inch moisture resistant, fire retardant marine plywood or galvanized steel. Transition ramps shall be hinged. A tunnel ramp shall be full width of tunnel. Nosing on ramps shall have abrasive anti-skid surface. Ramps shall slope starting in each tunnel to meet ADA slope requirements. Ramps shall not cut or mark the tunnel floor the ramp is riding over. Ramps shall be covered with 1/4-inch ribbed rubber matting with yellow chamfered edge.

d. Tunnels and rotunda floors, except as noted, shall also be covered with rubber flooring. Flooring shall be Owner-supplied and installed by the contractor.

e. Cab Floor Finish: One-quarter inch ribbed fire-resistant black rubber with anti-skid surface shall be installed from terminal side of service door to the aircraft spacer assembly. Rain gutter ends, door threshold and rubber matting seams shall be sealed with black silicone.

f. Gutters: Install yellow safety tape in all gutters.

13. Interior Ceiling:

    a. All ceiling areas shall be finished with linear solid metal-faced panels (matching the width of the light fixtures) or painted 20 gauge (minimum) coiled coated galvanealed steel panels running the width of the bridge. Panels shall be separated by approximately ½ to ¾ -inch black reveals. Panels shall be brushed aluminum tile or if utilizing aluminum or coiled coated galvanealed steel panels, finished in accordance with the specified exposed interior paint system. Owner shall make selection of either the brushed finish or the painted finish. The panels located at the ends of the light fixtures shall have a black finish to match the fixtures.

    b. The aluminum corner molding that finishes the ends of the ceiling panels and top edge of the wall panels is painted black to match the light fixture.

14. Interior flashing shall be l-inch wide x 1/8-inch thick with flat felt backing.

15. Architectural Metal and Trim Items: Anodized aluminum and other galvanized, aluminum, or stainless steel trim items shall have a satin finish.

16. Paints and flooring adhesives shall have a maximum VOC of 3.5 lbs. /gal for field applied applications. Stated VOC shall be un-thinned maximum as certified by the manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. The Contract Documents indicate the location of each aircraft position at each gate. The Contractor shall be responsible for verifying all locations of aircraft positions for the various types of aircraft serviced at each gate, and advise the Owner's Representative of any conflict or code violations prior to beginning the fabrication of the passenger boarding bridge. Any modification to the Documents as necessary to eliminate conflicts or code violations will be made by the Owner’s Authorized Representative (OAR).

2. Verify the exact terminal building door sill and bridge foundation elevation, and foundation bolt patterns and dimensions at each gate prior to preparation of shop drawings. Notify the Owner’s Authorized Representative (OAR) of any discrepancies with Contract Documents or passenger boarding bridge requirements.

3. Verify apron elevations at each bridge location. Coordinate these elevations with the bridge operation requirements, layout and maximum slope.

3.2 INSTALLATION

A. Structural Support Elements:

1. All anchor bolts are existing or provided by others in the foundation construction, and shall be protected from bending and damage during PBB installation. After installation, tack weld the anchor nuts to the base or provide two nuts. All zinc coating removed or damaged by welding or any other means shall be cleaned and repaired with galvanizing repair primer meeting the requirements of Federal Specification TT-P-641 G (1), Type II.

2. An approved non-shrink grout shall be used underneath the column base plate and leveling-plate. Grout shall be a no-iron mix to avoid rust marks. Grouting of the rotunda base plate shall be formed and poured using the holes in the base plate. Grouting by dry packing and filling the center area with bags and blocks will not be acceptable. The grouting shall be done to American Concrete Institute or structural standards and as approved by the Owner's Representative.

   a. Grout shall be 3-inches minimum and 7-inches maximum.
   b. Setting of rotunda requires a leveling nut and washer on each anchor bolt on the underside of the rotunda base plate and one or two nuts and one washer on the top.

3. Flooring Installation: GOAA shall furnish, at no cost to the Contractor, flooring for the passenger loading bridge and the fixed walkway flooring. The Contractor shall furnish all flooring accessories and install the flooring in strict accordance with the manufacturer's printed installation instructions and the following specifications.

   a. Prior to installation, verify with the Owner’s Authorized Representative (OAR) all edging techniques, lines of demarcation between flooring and hard surfaced floor and wall areas, and treatment at doors and thresholds.
   b. The contractor shall install the flooring by direct glue method, free of wrinkles.
   c. Adhesive and primer shall be compatible.
   d. Install edge strips where flooring abuts other flooring including door openings where thresholds are not indicated. Secure edge strips with countersunk flat head stainless steel screws at 12 inches on center maximum.
   e. Finished appearance shall be smooth, level, free from misalignment, neatly cut and closely fitted at projections and openings, with joints as close and inconspicuous as possible.

f. After the flooring installation is complete, Contractor shall clean all drains, gutters and rain diverters to remove any excess material, construction debris and flooring cutouts, to provide an unobstructed free flowing drainage system.

g. Contractor to vacuum the flooring and cover with non-staining, protective materials.

4. During the on-site delivery, storage, and installation process, the Contractor shall be responsible for securing all PBB elements, tools and equipment against hurricane force winds.

3.3 FIELD QUALITY CONTROL

A. Inspection:

1. Preliminary Inspection:

a. Manufacturer's representative shall perform a functional inspection and demonstration of each unit at the installation site in the presence of the Owner's Representative.

b. Verification of compliance with this Specification shall be accomplished by inspection, review of data, demonstration, testing (if required), or combination of these.

2. Final Acceptance Inspection:

a. Owner's Representative shall perform the final inspection of the unit after full compliance by the Contractor of all outstanding punch list items as determined from the preliminary inspection.

b. Full acceptance of the unit shall be made in writing to the Contractor after satisfactory completion of all punch list items as determined by the Owner's Representative.

B. Manufacturer's Field Services:

1. Provide qualified manufacturer's technical representative and service personnel during the entire installation of the boarding bridge to assure a proper installation, and to ensure adequate and reliable field service support to correct any and all equipment failures that normally occur during the initial operating period.

2. In addition, this field service support representation shall be on-site from 6 a.m. to 12 a.m. midnight for two calendar day after each gate enters service as scheduled by the Owner, and the following one day thereafter in accordance with the warranty provisions of PART 1 - GENERAL 1.11 WARRANTY.

3. This representation shall be available to the Owner's Representative at no charge for the first 60 days after installation. The manufacturer's field service representative shall ensure the installer follows:

   a. The manufacturer’s field installation manual.
   b. Compliance with all safety requirements.
   c. Accurate and complete reports and records maintenance.

END OF SECTION 34 77 12